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U.S. DEPARTMENT OF AGRICULTURE

No. 136

Contribution by the Office of Public Roads, Logan Waller Page, Director.
February 12, 1915.

HIGHWAY BONDS:

A COMPILATION OF DATA AND AN ANALYSIS OF ECONOMIC FEATURES AFFECTING CONSTRUCTION AND MAINTENANCE OF HIGHWAYS FINANCED BY BOND ISSUES, AND THE THEORY OF HIGHWAY BOND CALCULATIONS.

BY

LAURENCE I. HEWES,

Chief, Economics and Maintenance, Office of Public Roads,

and

JAMES W. GLOVER,

Professor of Mathematics and Insurance, University of Michigan,
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INTRODUCTION.

The practice of issuing bonds for highway and bridge construction by counties and their subdivisions has become common. In 1,230 counties, or 41.1 per cent of all the counties in this country, there were outstanding highway bonds on January 1, 1914. The total amount of such bonds voted,[1] as ascertained by the Office of Public Roads up to that date, was $286,557,073, of which township bonds alone amounted to $57,153,718. The amount of outstanding local highway bonds on January 1, 1913, was approximately $202,007,776. This amount was increased during the year 1913 by current issues noted below, but was also slightly decreased by maturing payments.

The county highway bond is essentially a municipal bond; that is, a bond issued by a public corporation. Statistics indicate that all municipal bonds constitute about 20 per cent of the total of all bonds issued, while Government bonds are about 10 per cent. Municipal bonds are regarded as excellent investments and are frequently used by banks as a second reserve. The amount of highway bonds issued is indicated by comparison with the $79,741,688 of irrigation and drainage bonds authorized in the interval from 1907 to 1912, inclusive.

[1] "Voted" is almost equivalent to "issued," except in State highway bonds. The difference between bonds voted and bonds sold in 1912 was a little over 3 per cent.

The progress of the local highway-bond movement is further indicated by the diagram of first issues for the interval 1900–1913. Dates of first issues were reported, however, for only 579 counties. First issues for 1912 and 1913 are practically complete. (Pl. I, fig. 1.)

During the past three years county, district, and township highway and bridge bonds were voted as follows: 1911, $29,200,022; 1912, $32,022,703; 1913, $50,445,756; making a total of $111,668,481.

There have also been voted State highway bonds which now total $158,590,000.[1] The grand total of all highway bonds voted and reported to the Office of Public Roads to January 1, 1914, is, therefore, $445,147,073.

There is given in Appendix A of this publication a list of all the State highway bonds with their dates of issue, terms, and nominal interest rates, together with other pertinent information concerning the issues.

In Appendix B are given three lists of local highway and bridge bonds. First there is a list of county and district highway and bridge bonds voted to January 1, 1914, with their terms and interest rates where reported. A similar table of township bonds is next presented. In a separate table is a list, by counties, districts, and townships in the several States, of highway and bridge bonds reported voted during each of the years 1912 and 1913.

The approximate distribution of local highway bonds is shown in the map, Plate II, by counties. State highway bonds are not included.

In collecting data for this publication the Office of Public Roads corresponded directly with county and township officials and the tables of bonds were submitted to State highway officials and other State officials for corrections and additions. Many county officials failed to state the term of the highway bond issues; it was found, however, that the mean term for approximately $47,000,000 issued prior to 1913 was 24.8 years. For the years 1912 and 1913, the term of issue, the number of issues, and the total amount issued by municipalities with complete reports are presented in the following table:

TABLE 1.—*Bond issues during 1912 and 1913 in counties, districts, and townships, with complete returns.*

Total number of issues.	Terms of issues.	Total amounts of issues.
17	5-year	$442,175
100	10-year	5,165,383
13	15-year	1,266,500
68	20-year	8,906,538
31	25-year	5,518,150
45	30-year	7,399,000
129	Serials	15,300,819
47	Above 30-year	7,170,971
47	Other term	1,816,541

[1] Including $3,415,000 issued by Connecticut, Massachusetts, and New Hampshire in 1913. Massachusetts authorized, in 1912, $5,000,000 to be issued during the years 1913 to 1917, inclusive, which is part of the total given. New York's second $50,000,000 will probably not be entirely issued for several years.

These figures represent 61.2 per cent of all the counties, townships, and districts reporting bond issues during 1912 and 1913.

The reports on the mileage of road constructed from the proceeds of local bond issues are very incomplete and in many instances contradictory. After eliminating all reports which were obviously incorrect or defective, a list of counties and districts giving complete returns of classified mileage of roads constructed has been made. A similar list for township work has also been made. These two lists are presented in Appendix B. It is quite probable that omissions in reports from counties and their subdivisions concerning mileage built are due in part to the frequent changing of local officials.

It will be seen from the diagram of first issues (Pl. I, fig. 1) and from the fact that probably over 80 per cent of local bonds for highways and bridges are still outstanding (see p. 3), that the highway bond movement has yet to meet the test of repayment. The maximum outlay for retirement of outstanding highway loans will apparently be reached in about 20 years.

If highway bond issues are to continue successfully, certain fundamental principles require attention. They are, therefore, discussed briefly in this publication. Necessary information is presented in considerable detail with illustrations and tables to guide highway officials in borrowing and expending highway funds.

COUNTY HIGHWAYS.

The highways of a county may usually be classified into main market roads, intercounty roads, and neighborhood roads. A relatively large percentage of the total mileage—more than 80 per cent in many counties—may be classed as neighborhood roads, which are either feeders to market roads or crossroads of relatively small importance. The intercounty roads are usually in part also main market roads. The market roads are, therefore, the roads for which the question of borrowing money frequently arises. The total mileage of main market roads varies greatly from county to county, but usually does not exceed 150 miles.

The distribution and individual lengths of market roads is of much importance to the highway engineer, who must plan for improvements. Rules can not be laid down which will apply universally for the selection of such roads. The area served by a given market road depends upon the length of the road and the form of the road network, which, in turn, is largely governed by topography and the situation of shipping points. In regions where the public land survey system prevails the roads very generally follow the section lines and radial roads are not common.

It is usual to find from four to eight main market roads radiating from market centers. The average number of such roads of considerable length is about six for each shipping point. The traffic on

radial roads will tend to vary inversely with their number. Plates IV, VI, and IX show the distribution of the main market roads in three counties.

ECONOMIC VALUE OF THE MARKET ROAD.

The service rendered by highways radiating from a town may be measured directly by the tonnage which is hauled over them; and their economic importance is indicated by this tonnage and varies directly with it. There are two ways of computing the tonnage of traffic on a road: (a) By actual count, and (b) by determining traffic areas supplemented with producers' and merchants' estimates of tonnage.

The actual count of traffic determines the average number of teams hauling produce each day, their loads, and the average distance traveled. From the count on a sufficient number of days a close estimate of the average annual traffic may be had.

TABLE 2.—*Traffic record of seven unimproved roads.*

Road No.	Location.[1]	Length in miles.	Tons per day, each area.	Average haul (nearest mile).	Equivalent annual ton-miles.	Merchants' and producers' estimates (ton-miles).	Traffic area (acres).	Reported costs (cents per ton-mile).
1	Lauderdale County, Ala. (2)	28.3	58	10	367,894	228,046	154,432	16.0
2	Boone and Story Counties, Iowa (16)	45.1	10	2	162,342	105,662	113,521	37.2
3	Cumberland and Sagadahoc Counties, Me. (8)	32.1	18	4	227,451	.....	38,182	23.6
4	Leflore County, Miss. (3)	24.1	33	7	197,386	90,628	60,736	36.2
5	Montgomery County, Md. (1)	5.4	21	2	14,044	5,892	12,531	26.0
6	Muskingum County, Ohio (2)	20.9	28	6	111,026	132,711	41,952	28.0
7	Jackson County, Oreg. (3)	50.5	11	4	51,810	32,170	73,881	36.6
	Totals and averages	206.4	26	5	1,131,953	.....	495,235	29.1

[1] Numbers in parentheses indicate the number of traffic areas.

From a map, supplemented by field observations, the traffic area served by a highway may be determined. This is the area on which originates market produce and for which supplies must be hauled from market. In a wheat country, for example, the average annual wheat acreage tributary to a highway will determine approximately the principal market traffic. Even a rough estimate of the traffic area is valuable for determining the relative importance of highways and indicates the order in which their improvement should be undertaken. It is also an excellent check on traffic count. Traffic data for a number of roads recently investigated by the

Office of Public Roads are given in Table 2. Actual traffic count was made four times for seven consecutive days on all the roads. The traffic areas, traffic estimates, and the hauling-cost data were determined in the field. The weight derived from loaded teams and motor trucks only is entered in this table, and the ton-mile hauling costs include a slight increment for loading and unloading.

Highway improvement with borrowed money must be regarded as an investment. The only way, however, that a measurable income arises from the investment is by the reduction of hauling costs. From the standpoint of public economy the annual cost of hauling represents the operating expenses of the road system. The direct return upon the highway investment, then, is the reduction in operating expenses. This difference between the old hauling costs and the hauling costs over the improved roads is a real saving to the community. In the language of railroad bookkeeping, this difference is an operating income to the community. It is invariably true that the improvement of market roads is followed by an increase in annual tonnage, so that estimates based on the existing tonnage are usually conservative. Doubtless much more money can be spent for well-planned and well-built roads without overcapitalizing them.

The unit in which hauling costs are measured is the ton-mile. The cost of hauling a ton 1 mile on a poor road probably varies on an average from 20 to 35 cents. (See Table 2.) It depends on the condition of the road and changes greatly during the year. Recent figures for hauling over unimproved roads in the mountain regions of West Virginia and Kentucky also show seven instances where the cost per ton-mile varied from 23 to 37 cents. Ton-mile costs as low as 10 cents are common in Europe on first-class highways. Even with the extreme variations of wages it is doubtful if the cost per ton-mile anywhere in this country on an adequately improved road exceeds 15 cents. Cross ties were hauled over improved gravel roads in Spotsylvania County, Va., in April, 1913, for about 12.7 cents and less per ton-mile, and apples were hauled by motor trucks on good roads in Jackson County, Oreg., in October, 1913, for a little more than 11 cents a ton-mile.

To understand how many tons a highway can carry in a year, assume a market town from which radiate six roads uniformly distributed and 12 miles long. There is then a circular traffic area of 12 miles radius and each road serves theoretically one-sixth of this area, which is 75.4 square miles. The average haul for each separate road is about 8 miles. (See p. 8.) If each acre tributary to this road supplies only 200 pounds of produce, which must move to market an average distance of 8 miles, the road carries an annual traffic of at least 38,605 ton-miles. Another way to view this traffic

is to divide the total number of tons by the number of hauling days, which is usually taken at 300. With an acreage yield of 200 pounds there result 16 tons per day which may be assumed to move an average distance of 8 miles. This would make a total of 128 ton-miles daily. The daily average weight over the entire road is therefore about 10.7 tons. The tonnage hauled is the most direct and reliable basis from which to determine the economic value of a road. (See Table 2.)

It is common to find that when a poor market road is improved the cost of hauling is reduced by from 2 to 10 cents per ton-mile. The saving to the community during a year can then be readily computed for each mile. (See Pl. III, fig. 2.)

Table 3 shows the annual saving per mile and the capitalized amount of this annual saving at 5 per cent interest for daily traffic varying from 5 to 80 tons.

TABLE 3.—*Annual saving per mile in hauling costs at 5 cents per ton-mile reduction.*

Tons per day.	Total saved in year of 300 days.	Capitalized at 5 per cent.	Tons per day.	Total saved in year of 300 days.	Capitalized at 5 per cent.
5	$75	$1,500	45	$675	$13,500
10	150	3,000	50	750	15,000
15	225	4,500	55	825	16,500
20	300	6,000	60	900	18,000
25	375	7,500	65	975	19,500
30	450	9,000	70	1,050	21,000
35	525	10,500	75	1,125	22,500
40	600	12,000	80	1,200	24,000

If the roads do not radiate uniformly from a town it is evident that in a uniformly producing area the traffic lost to one road must go over some adjoining road. However produce is distributed along the road, in general, the portion of the road nearer the market will receive much more use than the distant portion. The first few miles of radial road from a town are also much used by vehicles other than market vehicles.

Although a very important matter, the average haul on a market road is somewhat difficult to determine. It may be estimated from the maximum haul or the known radius of the traffic area,[1] and may usually be assumed to be two-thirds of the average maximum haul.

To show further the service which market roads render to a community, there is given in Table 4 the yearly and daily tonnage pass-

[1] In Bulletin No. 49 of the Bureau of Statistics of the U. S. Department of Agriculture, entitled "Cost of Hauling Crops from the Farms to Shipping Points," the average haul is assumed to be the radius of the circle whose area is one-half the area of a circle whose radius is the maximum haul. The average haul is then about seventy-one hundredths of the maximum haul. If all produce on a traffic area of one-sixth of a complete circle were hauled directly from the point where it originates to the market at the center, the resulting average haul would be sixty-seven hundredths of the maximum haul, which is the radius of the sector. If all produce were first concentrated on the middle radius of the sector, the average haul resulting would be sixty-four hundredths of the radius.

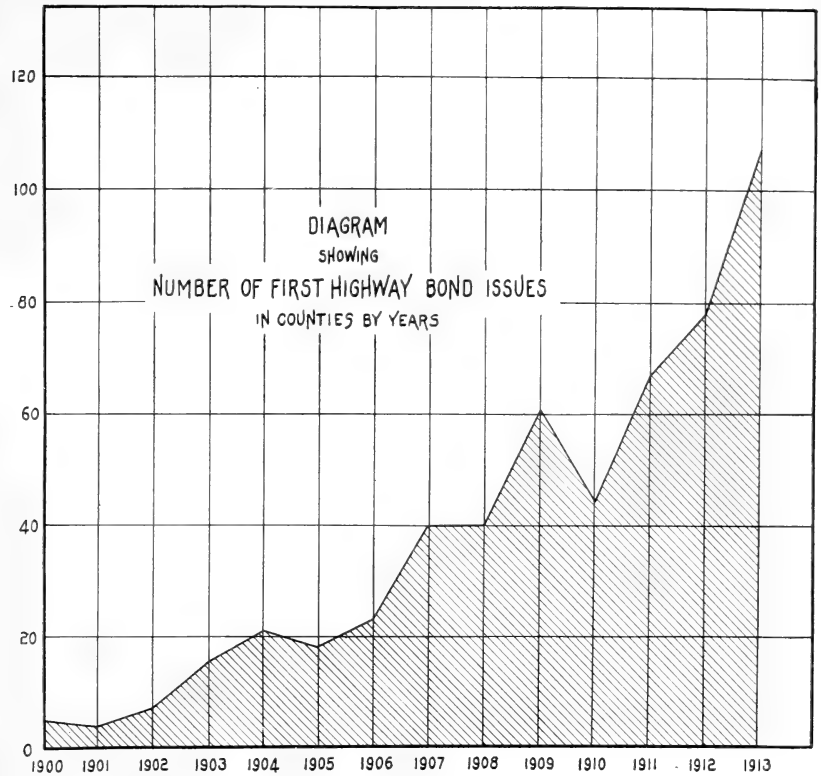
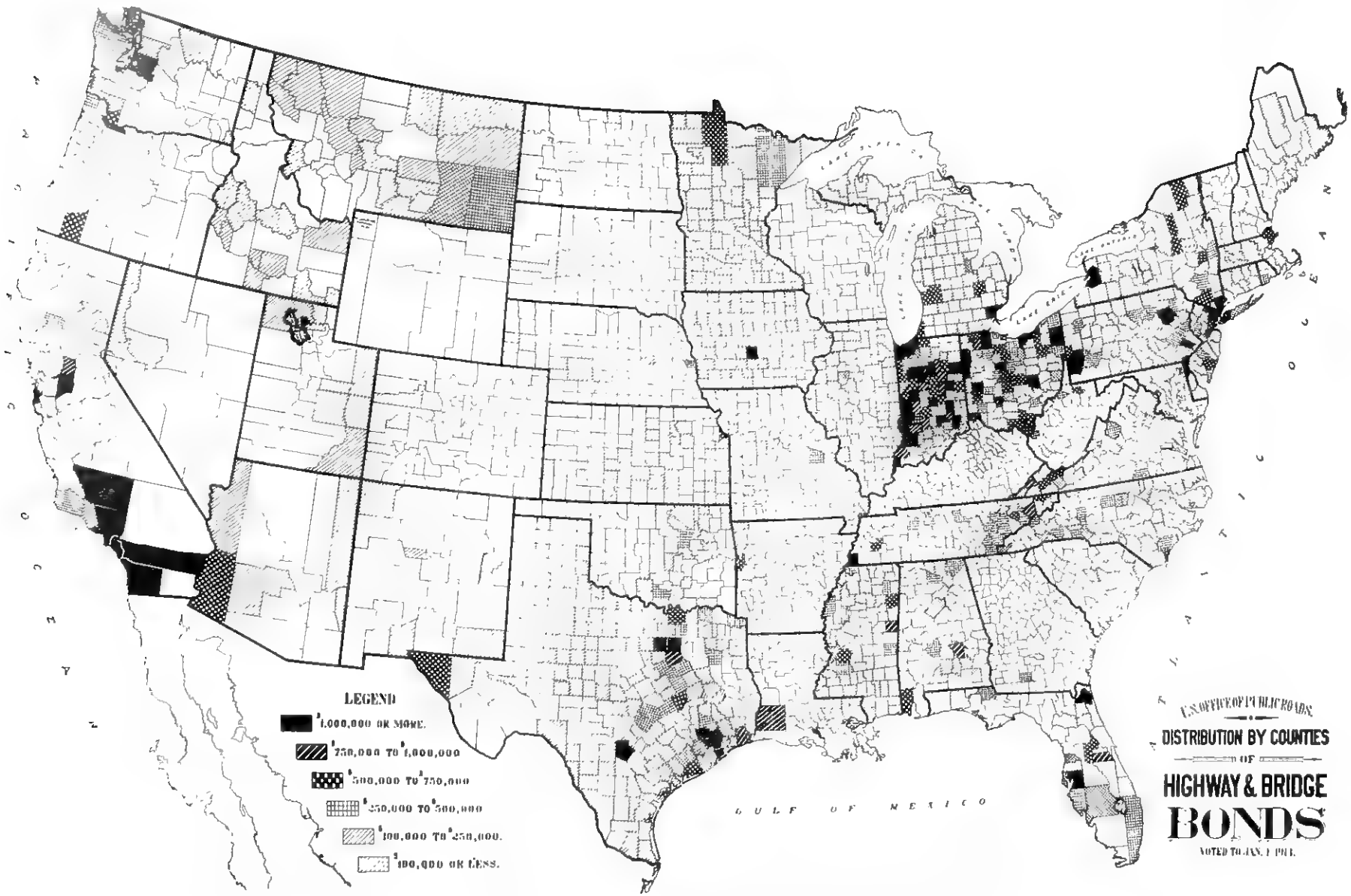


FIG. 1.—DIAGRAM SHOWING NUMBER OF FIRST HIGHWAY BOND ISSUES IN COUNTIES BY YEARS.

FIG. 2.—POOR MACADAM CONSTRUCTION OF 1911 AFTER 1 YEAR.



MAP OF THE UNITED STATES SHOWING THE DISTRIBUTION BY COUNTIES OF HIGHWAY AND BRIDGE BONDS VOTED TO JANUARY 1, 1914.

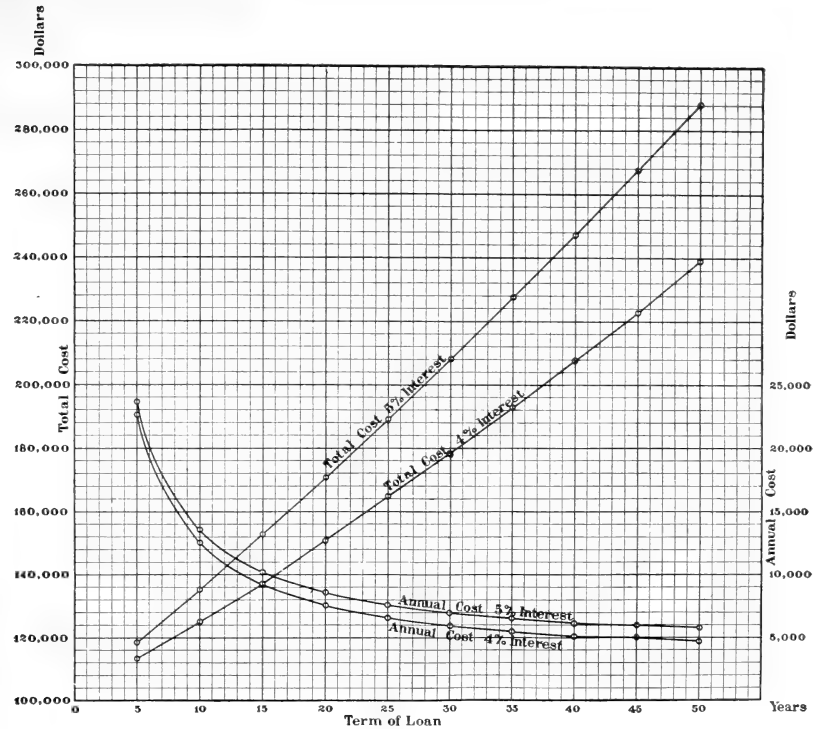


FIG. 1.—DIAGRAM SHOWING THE RELATION BETWEEN ANNUAL AND TOTAL COST AND THE PERIOD OF HIGHWAY BONDS—$100,000 SINKING FUND, 3½ PER CENT.

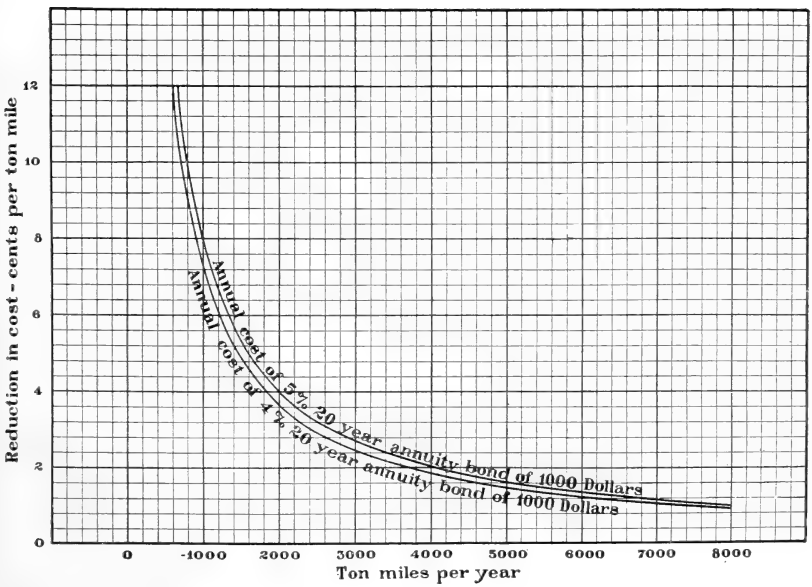
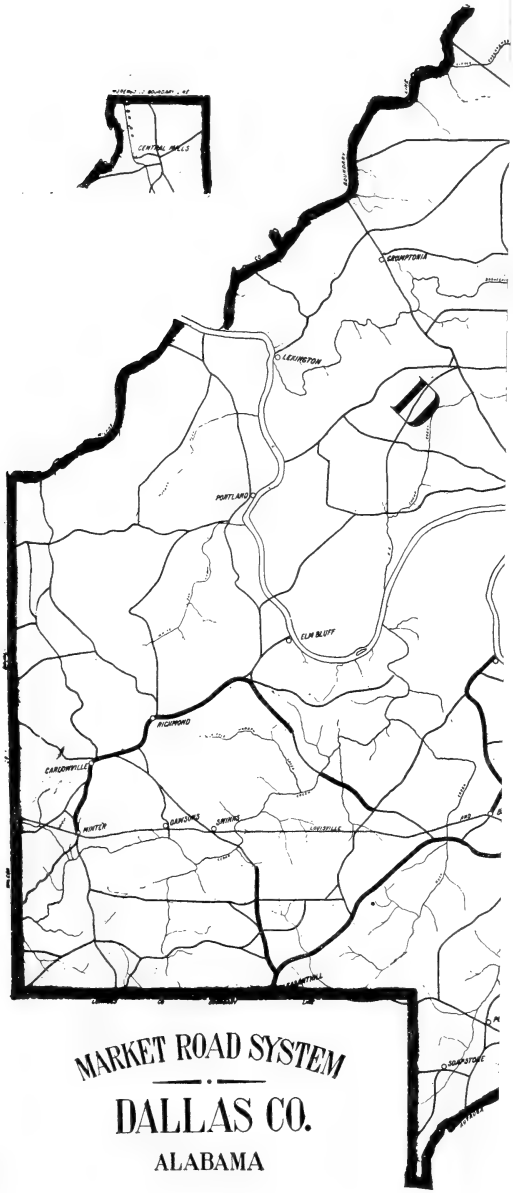
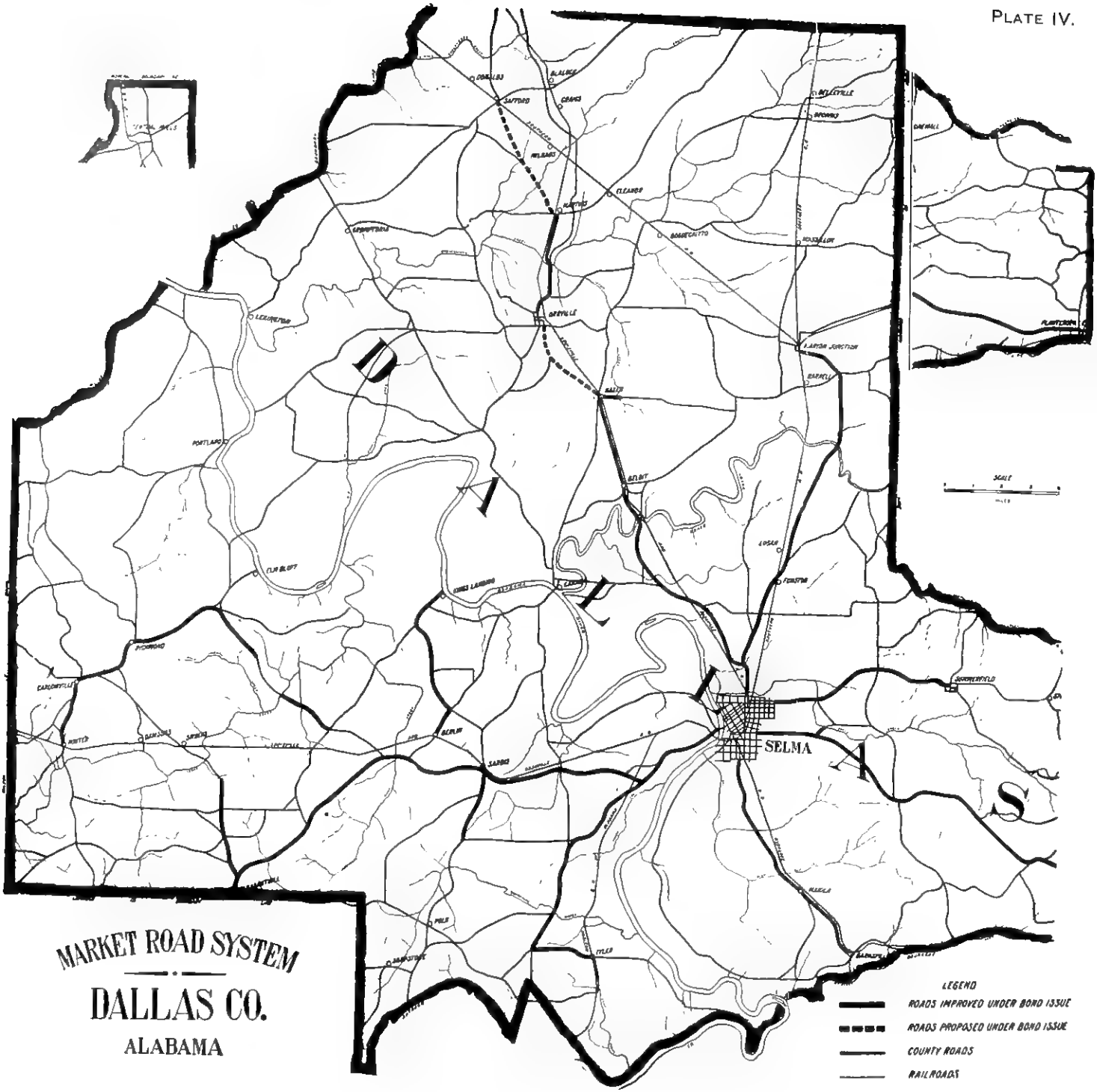


FIG. 2.—DIAGRAM SHOWING THE RELATION BETWEEN TOTAL REDUCTION IN COST OF HAULING AND ANNUAL COST OF A $1,000 BOND.



MAP SHOWING MARI

PLATE IV.



MAP SHOWING MARKET ROAD SYSTEM, DALLAS COUNTY, ALA.

ing over six market roads assumed uniformly distributed about a market center and extending from 1 to 15 miles through a territory each acre of which yields the same weight of market products.

TABLE 4.—*Theoretical average tonnage on each of six uniformly distributed market roads.*

Maximum haul.	Average haul.	Uniform yield per acre of—								
		One-tenth ton.			One-fourth ton.			One-half ton.		
		Total tons per year.	Tons hauled per day.		Total tons per year.	Tons hauled per day.		Total tons per year.	Tons hauled per day.	
			Over first mile.	Over eighth mile.		Over first mile.	Over eighth mile.		Over first mile.	Over eighth mile.
1	0.66	33.5	0.07	.....	88.8	0.17	.....	167.5	0.34	.....
2	1.32	134.0	.40	.....	335.0	1.00	.....	670.0	2.01	.....
3	2.00	301.6	.96	.....	754.0	2.40	.....	1,508.0	4.80	.....
4	2.67	536.2	1.74	.....	1,340.5	4.36	.....	2,681.0	8.71	.....
5	3.33	837.8	2.75	.....	2,094.5	6.87	.....	4,189.0	13.74	.....
6	4.00	1,206.2	3.98	.....	3,015.5	9.95	.....	6,031.0	19.90	.....
7	4.67	1,642.2	5.43	.....	4,105.5	13.58	.....	8,211.0	27.15	.....
8	5.33	2,144.8	7.11	0.85	5,362.0	17.76	2.13	10,724.0	35.52	4.25
9	6.00	2,714.5	9.00	2.75	6,786.3	22.51	6.88	13,572.5	45.02	13.75
10	6.67	3,351.2	11.13	4.87	8,378.0	27.82	12.18	16,756.0	55.63	24.35
11	7.33	4,055.8	13.47	7.22	10,138.5	33.68	18.05	20,279.0	67.35	36.10
12	8.00	4,825.7	16.04	9.79	12,064.3	40.10	24.48	24,128.5	80.20	48.95
13	8.67	5,663.3	18.83	12.58	14,158.2	47.08	31.45	28,316.5	94.15	62.90
14	9.33	6,568.0	21.85	15.59	16,420.0	54.63	38.98	32,840.0	109.25	77.95
15	10.00	7,540.0	25.09	18.83	18,850.0	62.73	47.08	37,700.0	125.45	94.15

The average acreage yield in pounds or the acreage coefficient varies with the locality. As market roads are usually located through farming country, the weight of crops per acre of farm land is a good indication of the tonnage originating on market roads.[1] The report of the 1910 Census shows an approximate average product of 332 pounds per acre of farm land. The average yield per acre on *improved* farm land in crops was 1,674 pounds.[2] The average weight per acre of forest products on unimproved farm land was 122 pounds.[3]

It is found that usually 20 per cent of the roads in any county carry nearly all the traffic—possibly 90 per cent of the total. In the United States 20 per cent of the total mileage of roads is about 440,000 miles. There is an average of about 2,000 acres of *farm* land to each mile of such road, which should represent about 65 per cent[4]

[1] There is a considerable return haul of fertilizer, fuel, kerosene, supplies, wire fence, etc., which can be partially determined by thorough inquiry of dealers.

[2] A careful computation of the weight per acre of all marketed crops in Tompkins County, N. Y., based on the data of Bulletin No. 295 of the Cornell Agricultural Experiment Station, gave 0.51 ton per acre of land in cultivation, which was 70 per cent of the total farm area and 63 per cent of the total area. The acre yield for the entire area was, therefore, 0.35 ton.

[3] These figures are derived by determining the weight and acreage of each crop reported and by making reasonable assumptions as to distribution in the case of fruits, etc., where acreage was not given. (See Table 2.)

[4] The average per cent of lands in farms in 39 States which reported more than 20 per cent of their areas in farms in 1910 was 65.16.

of the adjacent land. On each of the six radial market roads which have been assumed for the calculations above there would be a traffic area of 4,021 acres and a *farm* area of 2,614 acres per mile.

COST OF HIGHWAY CONSTRUCTION.

The cost of a given type of highway varies, but the range of variation has become comparatively well defined for each type within a given region. The standard of construction for any given type is now also generally understood and adhered to in the best practice. As this standard becomes more generally adopted, the price variation for similar local conditions will become less. In Table 5 there are given examples of cost per mile for three types of modern State highways. These averages are taken from lists of State construction jobs which are tabulated in Appendix C.[1] The standard which present specifications represent is a necessary standard evolved as the result of 20 years of modern road building. When these standards are ignored, it is usually at the expense of good work.

TABLE 5.—*Cost elements of three types of highways.*[1]

Type.	Drainage and grading.	Surfacing.	Total.	Drainage and grading.	Surfacing.
				Per cent.	*Per cent.*
Gravel (20 feet wide)	$1,817	$2,599	$4,416	41.15	58.85
Ordinary or water-bound macadam (15 feet wide)	3,400	5,815	9,215	36.90	63.10
Bituminous macadam (15 feet wide)[2]	2,765	7,533	10,298	26.85	73.15

[1] These cost elements were obtained from 87 gravel jobs and 104 macadam jobs in Maine and New Jersey, and from 53 bituminous-macadam jobs in Maine, Massachusetts, and New Jersey. The averages were computed by weighing each job with its relative length and reducing all costs by simple proportion to equivalent average widths of 20 feet and 15 feet respectively. The complete tables of cost elements on the 244 jobs are given in Appendix C.

[2] Includes eight jobs of bituminous resurfacing. (See footnotes, Appendix C.)

The cost of highway construction may be subdivided into (a) cost of enduring features and (b) cost of perishable features. When roads are built with accepted standards of grade, alignment, drainage structures, and foundations, the cost of such elements may be charged for enduring features. Whether roads so built result in the maximum percentage of permanent investment depends in part upon the cost and nature of the wearing surface. For example, a highway completed with all the best enduring features and then surfaced with gravel would show a higher percentage of cost for enduring features than the same road surfaced with more expensive material, as ordinary macadam or bituminous macadam. A poorly constructed gravel road, however, where enduring features had been slighted, would present a very high percentage of charge for temporary features. Macadam roads, so called, have been built with bond money by simply spreading broken stone in the mud. An example is shown in Plate I, figure 2.

[1] These examples were selected from States in which records were kept so as to permit cost analysis.

In issuing bonds for building highways the element of investment is of great importance. The allowable variations in grade and alignment are considerable, as are also the variations in the types of drainage structures. But there exists always a minimum standard below which it is uneconomical for any community to build on borrowed money.

It is manifestly poor policy to build an expensive surface or a relatively long-lived surface on defective grades with poor alignment, or where the drainage features are short-lived and temporary. Construction should be so adjusted to the service needed that its purpose is accomplished without waste. A county with impassable muddy clay roads must obtain, with a bond issue of $100,000, a maximum mileage of improvement. If roads are constructed costing $10,000 per mile, but 10 miles can be built. It is quite probable that the best economic result will be obtained by building 40 miles of road at a cost of $2,500 per mile. This money should be spent largely for enduring features, such as grading, drainage, etc.

The common error, however, in county bond issues is to fix the sum to be voted upon and then to demand an exorbitant mileage for that sum. There is presented in Table 5 and in Appendix C the percentage of the cost of drainage and grading, exclusive of surfacing, and the percentage of cost of the surfacing on a considerable mileage of road from several States.

Not all the surfacing need be a perishable feature. It is becoming more and more common to construct roads with surfaces built in two courses, the lower of which is regarded as a permanent feature of construction. This is particularly true of those types of road that are built with concrete foundations for bituminous-macadam, brick, or asphalt surfaces. Most hard roads are now seldom allowed to wear into the foundation course of the surfacing. It is probably conservative to regard 40 per cent of the surfacing cost of macadam or more enduring pavements as a cost for permanent features. Well-built macadam roads, from the recorded costs in Table 5, would therefore indicate a cost of 62 per cent of the total cost for permanent features and bituminous-macadam roads about 56 per cent. This method of estimating can not be applied to gravel or any natural soil road. Under most existing systems of maintenance the entire surfacing of such roads steadily deteriorates. It is generally accepted that roads built with surfaces entirely of concrete or with a brick pavement and a concrete foundation are permanent. It is not, however, yet known how long the best concrete surface will wear and it is certain that serious failures of concrete surfaces have resulted from poor construction. The best vitrified brick surfaces may have a life of 30 years or more, but repairs will usually be required and sufficiently exten-

sive data on the life of modern vitrified brick roads grouted with cement mortar are still lacking to fix the average life period.[1]

The danger of building roads with little attention to anything but the surface, with no provision for repair and maintenance, and with bonds of excessive term is, however, very serious. Complete returns of highway mileage built with local bond issues are not available, but there is given in Appendix B (Tables 25 and 26) a list of bond issues and mileage constructed with the proceeds where the reports are complete.

COST OF HIGHWAY MAINTENANCE.

Highways constructed with borrowed money should be strictly maintained.[2] Maintenance is necessary in order to insure to the community the maximum economic service by the road and also to preserve the investment. The cost of maintenance and repairs must, therefore, be studied at the outset. Unfortunately public records do not yet present complete data on the cost of either repair or maintenance, except in certain States which have highway departments.

Well-constructed gravel roads will sometimes sustain several years of traffic without showing marked deterioration, even when there has been no maintenance. Such roads sometimes even improve during the second season; more frequently, however, they show ruts or the formation of chuck holes. It can not be expected that the average life of a gravel surface will be greater than that of a macadam surface. The average interval for resurfacing macadam roads is between six and seven years. If a sum equal to two-thirds of the original cost of the gravel surface itself is provided for renewals at six-year intervals, it should be estimated at from $150 to $250 per mile per year. If $30 is then allowed for annual dragging and small repairs, the total annual cost of repair and maintenance of gravel roads would be from $180 to $280 per mile. The annual cost of strict maintenance is sometimes below $30. In Bennington County, Vt., during 1912, 175 miles of gravel roads were maintained at a cost of $20.70 per mile. The annual cost of maintenance and repair on sand-clay roads, including all necessary resurfacing at periodic intervals, should not be fixed at less than 10 per cent of the original cost.

The cost of repair and maintenance of water-bound macadam roads has been determined with considerable exactness from Massachusetts figures and checked by resurfacing charges in other States and in Germany. From $100 to $125 per year ordinarily pays for necessary small repairs, such as patching, cleaning culverts, etc.,

[1] For further information as to the life of roads, see Bulletin No. 48 of the Office of Public Roads, U. S. Department of Agriculture, "Repair and Maintenance of Highways," and Bulletin No. 23 of the U. S. Department of Agriculture, "Vitrified Brick as a Paving Material for Country Roads." These bulletins may be obtained from the U. S. Department of Agriculture.

[2] See Bulletin 48, Office of Public Roads, U. S. Department of Agriculture.

and from $400 to $425 per year is the necessary annual charge for resurfacing at periods varying from six to seven years. (See footnote 1, p. 12.) The sum of $525 per mile, on an average, should therefore absolutely maintain macadam roads if changes and increases of traffic are not excessive. It must be understood, however, that in many instances where macadam sufficed for the volume and character of traffic prior to 1906, it will not withstand the action of the motor vehicle traffic which has developed since that time.

Many miles of ordinary or water-bound macadam road have been resurfaced with bituminous materials and many miles of new bituminous-macadam road have been constructed. The logical maintenance of such highways is a surface treatment with bituminous material and rock screenings, clean gravel, or sharp sand. The cost of such surface treatment is from 4 to 12 cents per square yard, and it may be expected to last from one to three years, according to the density of traffic and the success of the application. Theoretically, perfect surface treatment would constitute absolute maintenance for a bituminous-macadam road. Such maintenance is seldom or never realized and bituminous-macadam roads doubtless require resurfacing at intervals. The cost of such resurfacing is not yet known. The average cost for repair and maintenance of 7,300 miles of highway in Connecticut, Massachusetts, New York, New Jersey, and Rhode Island for the year 1912 was about $800 per mile. A large part of this money was expended for bituminous resurfacing and bituminous surface treatment. There is some question whether the expenditure correctly measures the average cost of repairing and maintaining bituminous-macadam roads. In the State of New York, however, for the years 1911 and 1912 the average cost for repair and maintenance was $724 per mile upon a total average of 2,861 miles. The annual cost of repair and maintenance on Massachusetts State roads for the years 1910, 1911, and 1912 was, respectively, $642, $647, and $676 per mile for about 850 miles. For the most part these figures for New York and Massachusetts represent the cost per mile of resurfacing with bituminous material and of maintaining bituminous-macadam and water-bound macadam roads by surface treatment with bituminous material. It is clear, therefore, that $700 per mile is not an excessive estimate at present for the annual cost of all repair and maintenance of bituminous-macadam roads.

The cost of maintaining concrete roads is not yet known. It is known, however, that great care must be exercised in constructing such roads to insure their success. There have been cases where such roads began to disintegrate along the wheel tracks in less than a year, owing to defective concrete. Sometimes such roads have cracked so badly that it was necessary to remove the surface entirely. In other instances the necessary repairs have been very expensive.

Instances are also known where concrete road surfaces have shown a very high percentage of annual wear. In other cases there is apparently no measurable wear. If the road surface is built with the proper mix of concrete and carefully placed, it apparently should last indefinitely and not rut. Some cleaning of the surface and patching of joints and small depressions will be necessary at all times, so that the maintenance can not be entirely neglected.

The cost of repair and maintenance upon brick highways is very low. In most instances, where the construction is as nearly perfect as possible, almost no maintenance charges have resulted. Perfect construction, however, is seldom obtained.[1] It is not unusual to find depressions and points of wear in brick roads, but it is less common than formerly. Brick roads are now usually constructed on a concrete foundation, with very carefully selected vitrified brick, and with the joints filled with cement mortar. Their annual maintenance costs, although low, are not on record with sufficient continuity to supply accurate data.

It has not been customary for officials to face frankly the cost of maintenance and repair on bond-built highways at the time the bonds are issued and before construction begins. In fact, in the majority of cases where bonds have been issued by local authorities there has been no provision whatever for maintaining the roads when built. This is perhaps the gravest defect in the project of building highways by issuing bonds. The cost of all maintenance and repair over a series of years has ranged in the past from 6 to 10 per cent of the original cost of construction on the average and varies with the type of construction. Concrete roads and brick roads apparently are a marked exception to this rule. In future construction where the type of road is properly adapted to traffic and with careful maintenance from the outset the percentage of repair and maintenance cost should be lower.

THE BOND ISSUE.

Sinking-fund bonds.—The majority of highway bonds now outstanding have been issued as straight terminable bonds to be retired by sinking funds. Many such bonds now run for excessive terms. Although the term varies from 10 to 40 years, the average is nearly 25 years.[2] The fund to retire the bonds is accumulated by annual installments paid by the taxpayers and is supposed to draw interest continuously and to accumulate a sufficient amount to discharge the debt at maturity. The interest which the sinking fund draws is usually from 1 to 2 per cent less than the interest paid for the loan. Five per cent highway bonds are common with the sinking fund calculated to draw $3\frac{1}{2}$ per cent interest. Table 6 shows the annual payments to the sinking fund necessary to accumulate $1,000

[1] Cf. Bulletin 23 of the U. S. Department of Agriculture.
[2] Some issues—notably New York State—run 50 years. Cf. Appendices A and B.

at 3, 3½, and 4 per cent compounded semiannually for varying periods from 1 to 30 years.

TABLE 6.—*Annual payments which, with interest at 3, 3½, and 4 per cent, compounded semianually, will amount to $1,000 at the end of a term of years.*[1]

Years.	Annual payments.			Years.	Annual payments.		
	3 per cent.	3½ per cent.	4 per cent.		3 per cent.	3½ per cent.	4 per cent.
1	$1,000.0000	$1,000.0000	$1,000.0000	16	$49.5229	$47.5689	$45.6734
2	492.5562	491.3266	490.1000	17	45.8652	43.9283	42.0537
3	323.4583	321.8368	320.2221	18	42.6221	40.7032	38.8504
4	238.9468	237.1428	235.3498	19	39.7280	37.8279	35.9976
5	188.2699	186.3672	184.4796	20	37.1306	35.2499	33.4426
6	154.5102	152.5508	150.6104	21	34.7875	32.9267	31.1429
7	130.4175	128.4252	126.4560	22	32.6639	30.8236	29.0636
8	112.3666	110.3564	108.3733	23	30.7313	28.9116	27.1759
9	98.3436	96.3254	94.3382	24	28.9656	27.1670	25.4557
10	87.1402	85.1208	83.1366	25	27.3469	25.5696	23.8829
11	77.9872	75.9717	73.9954	26	25.8582	24.1024	22.4404
12	70.3721	68.3643	66.3996	27	24.4850	22.7508	21.1136
13	63.9399	61.9427	59.9924	28	23.2149	21.5024	19.8901
14	58.4372	56.4527	54.5191	29	22.0373	20.3465	18.7591
15	53.6780	51.7080	49.7928	30	20.9428	19.2739	17.7113

[1] In Appendix D, page 98, Example 9 shows the method of calculating this table.

Table 7 illustrates how an annual sinking fund of $32,345.83 accumulates for three years to $100,000.

TABLE 7.—*Accumulations of an annual payment of $32,345.83 with interest at 3 per cent compounded semiannually.*

Number of 6-month intervals.	Principal at beginning of 6-month intervals.	Interest during 6-month intervals.	Annual payment at end of 6-month intervals.	Total amount at end of 6-month intervals.
1	$0.00	$0.00	$0.00	$0.00
2	0.00	0.00	32,345.83	32,345.83
3	32,345.83	485.19	0.00	32,831.02
4	32,831.02	492.47	32,345.83	65,669.32
5	65,669.32	985.04	0.00	66,654.36
6	66,654.36	999.81	32,345.83	100,000.00

To obtain the necessary annual payments to produce any multiple of $1 it is necessary merely to multiply the tabular value in Table 6 by the corresponding multiple; thus, an annual sinking fund payment to retire $100,000 in 15 years at 3½ per cent would be $5,170.80. Table 33, pages 120 and 121, gives the yearly or periodic payments necessary to accumulate $1 in a given number of years or periods at varying rates of interest.

There are objections to the sinking-fund method of retiring highway bonds. It may not be possible to obtain continuously the requisite rate of interest on the sinking fund to discharge the debt at maturity. The existence of the sinking fund is a constant temptation to municipal officers to use it for purposes other than the purpose originally intended. If a county, for example, issues bonds for a second object, it is easy to argue that the sinking fund already accumulated may be used to purchase the new securities, and the finances

of the community are in a way to become much confused. This is particularly true since the officers in charge of such operations are frequently changing. Sinking fund tax levies may be deferred through carelessness or under pressure of other needs. The sinking fund always requires careful attention, because it does not progress automatically in most cases.[1] It has sometimes been entirely neglected. The total cost of a bond issue retired by a sinking fund will be greater in the end than the cost of the same bond issue made by either the annuity method or by the serial method.

Annuity bonds.—By the annuity method of issuing bonds both the principal and interest are discharged by constant annual or semiannual payments. The amount of each payment or installment is determined by the rate of interest and the term of the bond. It usually is necessary to subdivide the bond issue into individual bonds of $100, $500, or $1,000 each. The resulting periodic payment of principal and interest must vary slightly because of this adjustment. Tables 8 and 9 show, in detail, the schedule of principal and interest repayments upon a loan of $100,000 for 20 years, retired by this plan at 4 and 5 per cent per annum, respectively. The necessary adjustment to the nearest $100 bond is also shown. It will be seen that the amount of principal retired is small at first and constantly increases while the interest charge decreases. The sum of interest and principal remains constant, and this is an advantage as the tax is then uniform.

TABLE 8.—*Repayment of a 4 per cent $100,000 loan, including both principal and interest, by a uniform annual payment of $7,358.175 for 20 years.*[2]

	Adjusted to nearest cent.			Adjusted to $100 bonds.			
Years.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	$100,000.00	$4,000.00	$3,358.18	$100,000	$4,000	$3,400	$7,400
2	96,641.82	3,865.67	3,492.50	96,600	3,864	3,500	7,364
3	93,149.32	3,725.97	3,632.21	93,100	3,724	3,600	7,324
4	89,517.11	3,580.68	3,777.49	89,500	3,580	3,800	7,380
5	85,739.62	3,429.59	3,928.59	85,700	3,428	3,900	7,328
6	81,811.03	3,272.44	4,085.73	81,800	3,272	4,100	7,372
7	77,725.30	3,109.01	4,249.17	77,700	3,108	4,200	7,308
8	73,476.13	2,939.05	4,419.12	73,500	2,940	4,400	7,340
9	69,057.01	2,762.28	4,595.90	69,100	2,764	4,600	7,364
10	64,461.11	2,578.44	4,779.73	64,500	2,580	4,800	7,380
11	59,681.38	2,387.26	4,970.92	59,700	2,388	5,000	7,388
12	54,710.46	2,188.42	5,169.75	54,700	2,188	5,200	7,388
13	49,540.71	1,981.63	5,376.55	49,500	1,980	5,400	7,380
14	44,164.16	1,766.57	5,591.60	44,100	1,764	5,600	7,364
15	38,572.56	1,542.90	5,815.28	38,500	1,540	5,800	7,340
16	32,757.28	1,310.29	6,047.88	32,700	1,308	6,000	7,308
17	26,709.40	1,068.38	6,289.80	26,700	1,068	6,300	7,368
18	20,419.60	816.78	6,541.39	20,400	816	6,500	7,316
19	13,878.21	555.13	6,803.05	13,900	556	6,800	7,356
20	7,075.16	283.01	7,075.16	7,100	284	7,100	7,384
Totals		47,163.50	100,000.00		47,152	100,000	147,152

[1] In some States there are restrictions on the nature of county investments for sinking fund purposes.

[2] An additional table showing the annual payments necessary to discharge a loan of $1, with interest for varying terms and rates, is given in Table 36 on pages 126 and 127.

FIG. 1.—DALLAS COUNTY, ALA. WOODEN BRIDGE ON AN UNIMPROVED ROAD, 1 MILE NORTHWEST OF MARION JUNCTION.

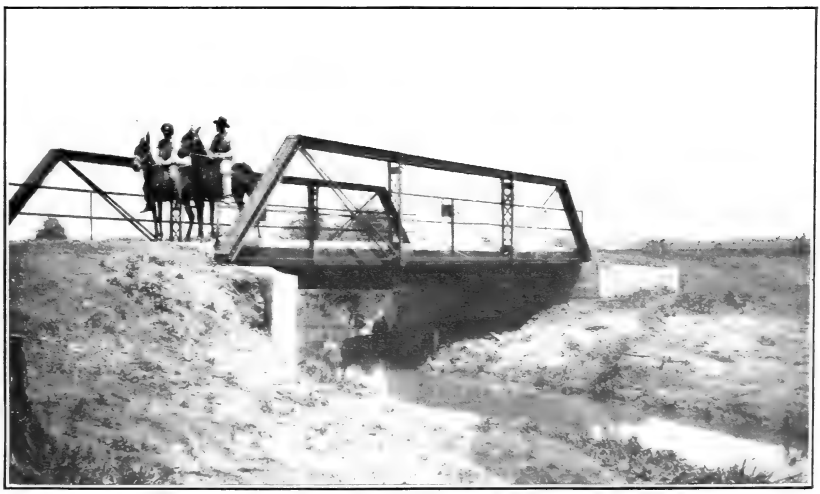
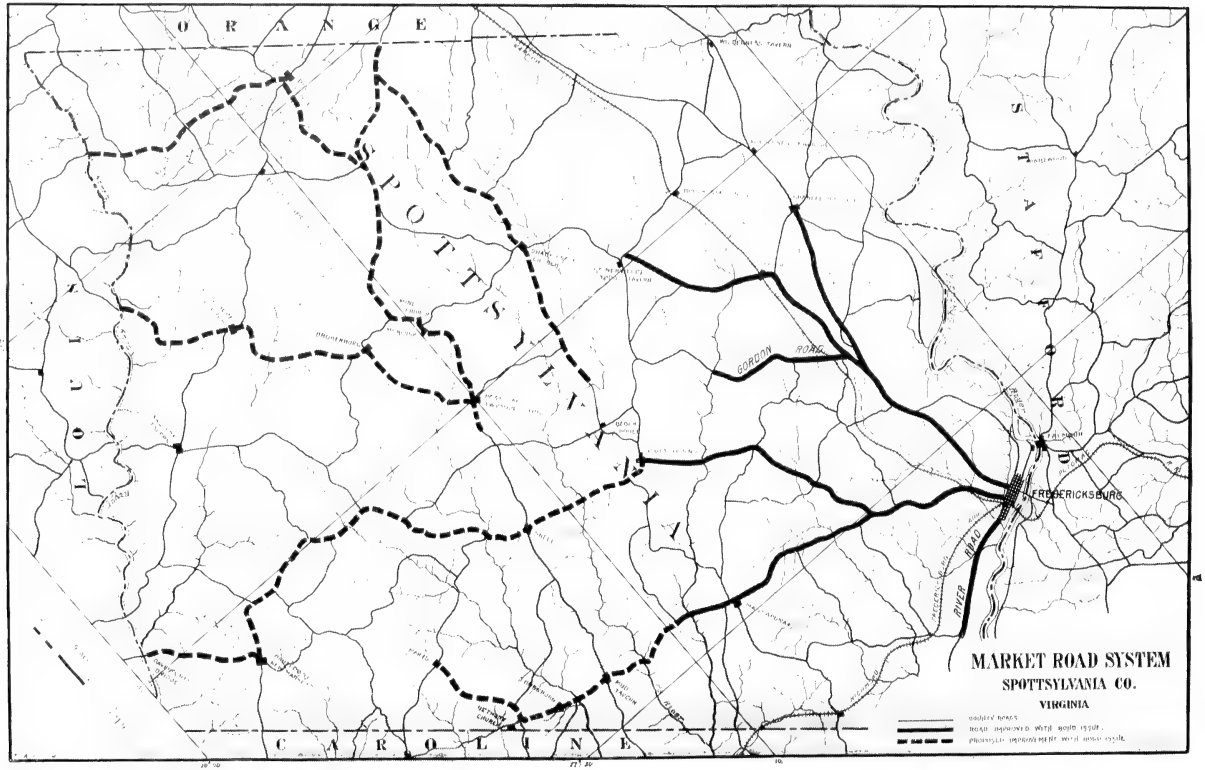


FIG. 2.—DALLAS COUNTY, ALA. NEW STEEL BRIDGE WITH CONCRETE FLOOR BUILT IN 1911 TO REPLACE THE BRIDGE IN FIGURE 1.



MAP SHOWING MARKET ROAD SYSTEM, SPOTSYLVANIA COUNTY, VA.

FIG. 1.—SPOTSYLVANIA COUNTY, VA. UNIMPROVED ROAD FROM FREDERICKSBURG TO CHANCELLORSVILLE, MARCH, 1910.

FIG. 2.—SPOTSYLVANIA COUNTY, VA. CHANCELLORSVILLE ROAD IMPROVED, MARCH, 1911.

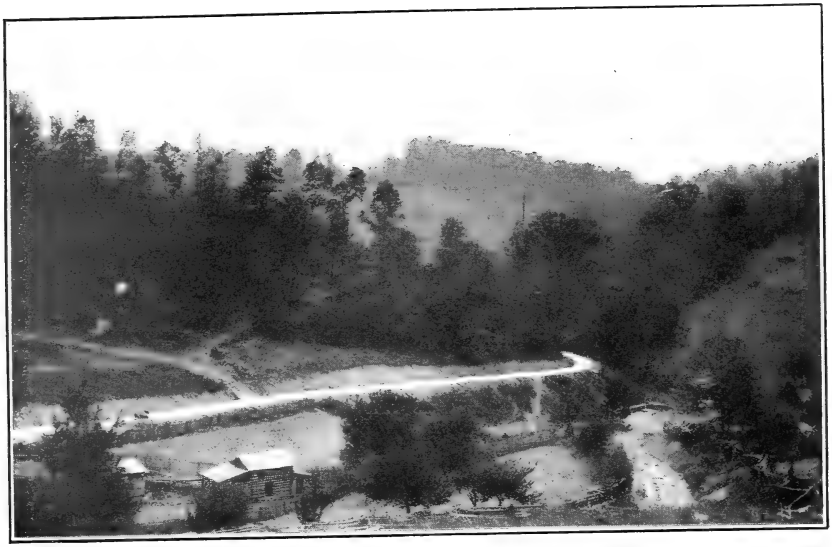


FIG. 1.—LEE COUNTY, VA. ONE AND ONE-HALF MILES FROM JONESVILLE; NEW MACADAM ROAD BUILT FROM BOND ISSUE; OLD ROAD SHOWN AT THE RIGHT FOREGROUND.

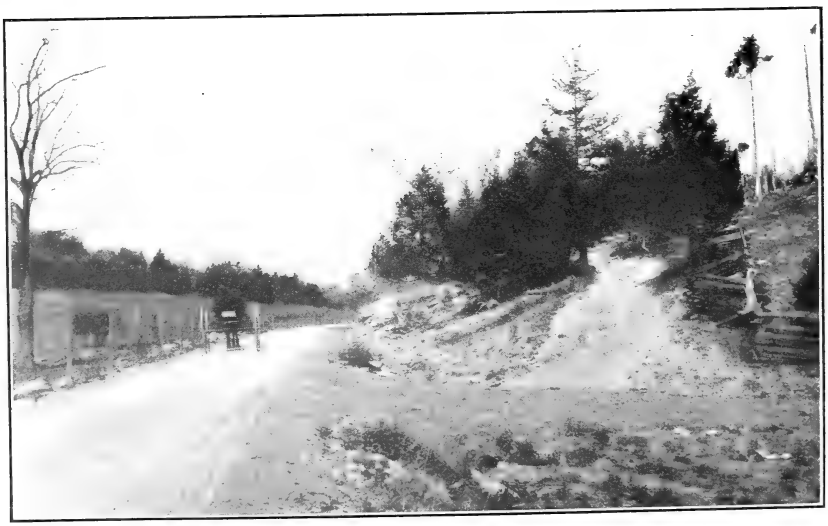
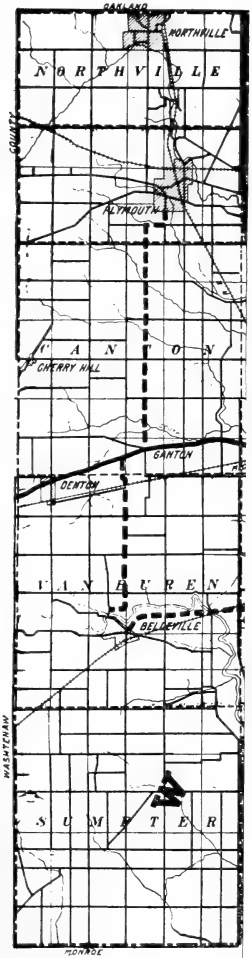
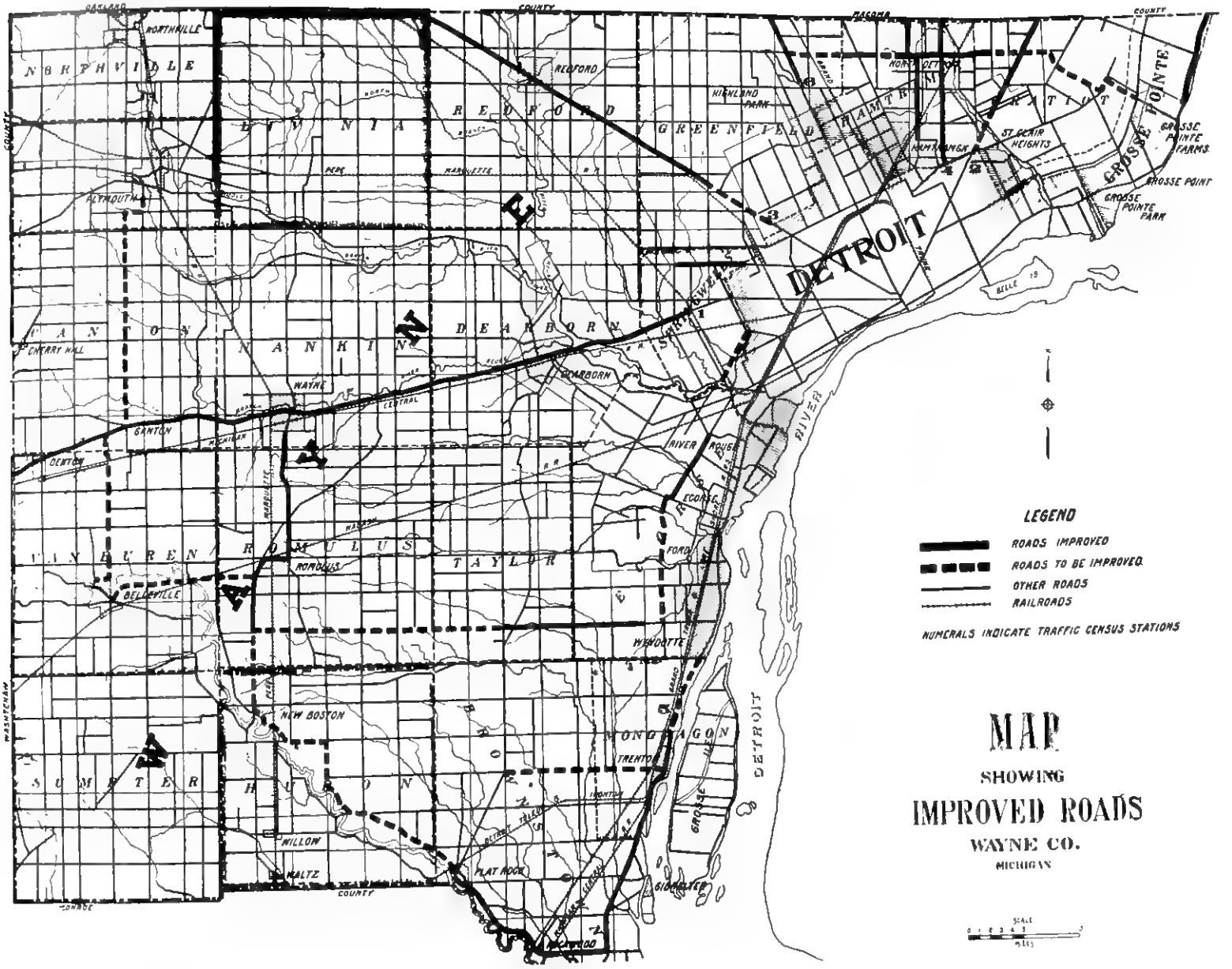


FIG. 2.—LEE COUNTY, VA. IMPROVED ROAD BUILT UNDER BOND ISSUE OF 1911 NEAR CUMBERLAND GAP; OLD ROAD IS SHOWN AT THE RIGHT.


OAKLAND
NORTHVILLE
NORTHVILLE
COUNTY
PLYMOUTH
PLYMOUTH
CANTON
CHERRY HILL
CANTON
DENTON
VAN BUREN
BELLEVILLE
WASHTENAW
SUMPTER
MONROE



MAP SHOWING IMPROVED ROADS, WAYNE COUNTY, MICH.

TABLE 9.—*Repayment of a 5 per cent $100,000 loan, including both principal and interest, by a uniform annual payment of $8,024.259*[1] *for 20 years.*

	Adjusted to nearest cent.			Adjusted to $100 bonds.			
Years.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Principal owing at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	$100,000.00	$5,000.00	$3,024.25	$100,000	$5,000	$3,000	$8,000
2	96,975.75	4,848.79	3,175.47	97,000	4,850	3,200	8,050
3	93,800.28	4,690.02	3,334.24	93,800	4,690	3,300	7,990
4	90,466.04	4,523.30	3,500.96	90,500	4,525	3,500	8,025
5	86,965.08	4,348.25	3,676.01	87,000	4,350	3,700	8,050
6	83,289.07	4,164.45	3,859.81	83,300	4,165	3,900	8,065
7	79,429.26	3,971.46	4,052.80	79,400	3,970	4,100	8,070
8	75,376.46	3,768.82	4,255.44	75,300	3,765	4,300	8,065
9	71,121.02	3,556.05	4,468.21	71,000	3,550	4,500	8,050
10	66,652.81	3,332.64	4,691.62	66,500	3,325	4,700	8,025
11	61,961.19	3,098.06	4,926.19	61,800	3,090	4,900	7,990
12	57,035.00	2,851.75	5,172.51	56,900	2,845	5,200	8,045
13	51,862.49	2,593.13	5,431.13	51,700	2,585	5,400	7,985
14	46,431.36	2,321.57	5,702.69	46,300	2,315	5,700	8,015
15	40,728.67	2,036.43	5,987.83	40,600	2,030	6,000	8,030
16	34,740.84	1,737.04	6,287.22	34,600	1,730	6,300	8,030
17	28,453.62	1,422.68	6,601.58	28,300	1,415	6,600	8,015
18	21,852.04	1,092.60	6,931.66	21,700	1,085	6,900	7,985
19	14,920.38	746.02	7,278.24	14,800	740	7,200	7,940
20	7,642.14	382.12	7,642.14	7,600	380	7,600	7,980
Totals	.....	60,485.18	100,000.00	.....	60,405	100,000	160,405

[1] Cf. Example 14, p. 101, for details of calculations.

Serial bonds.—The serial bond differs somewhat from the annuity bond, because, instead of keeping the annual payment of both principal and interest constant, the principal alone retired each year remains fixed. This type of bond has become more common for highway purposes in recent years, and during 1912 and 1913 the number of serial issues exceeded the number of issues for any other single given term. The Office of Public Roads received reports for these two years of $15,300,819 in serial highway bonds, which is over 20 per cent of the total county and district bonds for which the period or term of issue was reported. In Tables 10 and 11 are given the necessary annual payments of interest and principal for an issue of $100,000 for 20 years at 4 and 5 per cent, respectively, where the bonds are retired by annual payments of $5,000 each. The first retirement is sometimes deferred for a number of years.

TABLE 10.—*Schedule of interest and principal to retire a serial loan of $100,000 at 4 per cent, with annual principal repayments of $5,000.*

Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.	Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	$100,000	$4,000	$5,000	$9,000	12	$45,000	$1,800	$5,000	$6,800
2	95,000	3,800	5,000	8,800	13	40,000	1,600	5,000	6,600
3	90,000	3,600	5,000	8,600	14	35,000	1,400	5,000	6,400
4	85,000	3,400	5,000	8,400	15	30,000	1,200	5,000	6,200
5	80,000	3,200	5,000	8,200	16	25,000	1,000	5,000	6,000
6	75,000	3,000	5,000	8,000	17	20,000	800	5,000	5,800
7	70,000	2,800	5,000	7,800	18	15,000	600	5,000	5,600
8	65,000	2,600	5,000	7,600	19	10,000	400	5,000	5,400
9	60,000	2,400	5,000	7,400	20	5,000	200	5,000	5,200
10	55,000	2,200	5,000	7,200					
11	50,000	2,000	5,000	7,000	Totals.	.....	42,000	100,000	142,000

TABLE 11.—*Schedule of interest and principal to retire a serial loan of $100,000 at 5 per cent, with annual principal repayments of $5,000.*

Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.	Years.	Principal outstanding at beginning of year.	Interest for year.	Principal repaid at end of year.	Total.
1	$100,000	$5,000	$5,000	$10,000	12	$45,000	$2,250	$5,000	$7,250
2	95,000	4,750	5,000	9,750	13	40,000	2,000	5,000	7,000
3	90,000	4,500	5,000	9,500	14	35,000	1,750	5,000	6,750
4	85,000	4,250	5,000	9,250	15	30,000	1,500	5,000	6,500
5	80,000	4,000	5,000	9,000	16	25,000	1,250	5,000	6,250
6	75,000	3,750	5,000	8,750	17	20,000	1,000	5,000	6,000
7	70,000	3,500	5,000	8,500	18	15,000	750	5,000	5,750
8	65,000	3,250	5,000	8,250	19	10,000	500	5,000	5,500
9	60,000	3,000	5,000	8,000	20	5,000	250	5,000	5,250
10	55,000	2,750	5,000	7,750					
11	50,000	2,500	5,000	7,500	Totals.	.....	52,500	100,000	152,500

Comparison of serial, annuity, and sinking-fund bonds.—It will be noticed that the total expense to the community under the serial plan is somewhat less than under the annuity plan. The expense by either method is, however, considerably less than the expense under the sinking-fund plan. For the purpose of comparison the total expense to the community under each plan is assembled under Table 12.

Tables 8 to 11, inclusive, are computed with interest payable annually. Bonds with interest payable semiannually sell better. Similar tables or schedules for the annuity and serial plans of bond issues to conform to semiannual interest payments can be easily prepared. Schedules can also be prepared to show the progress of a bond loan when the bonds are bought at a premium or discount.[1]

TABLE 12.—*Total cost of a loan of $100,000 for 20 years, interest compounded annually.*

Annual interest on bonds.	Sinking fund compounded annually at—			Annuity.	Serial.
	3 per cent.	3½ per cent.	4 per cent.		
4	$154,431	$150,722	$147,163	$147,163	$142,000
4½	164,431	160,722	157,163	153,752	147,250
5	174,431	170,722	167,163	160,485	152,500
5½	184,431	180,722	177,163	167,359	157,750
6	194,431	190,722	187,163	174,369	163,000

In a bond issue by any given plan the amount, the interest, and the term may be fixed at will, but when this is done the annual repayments of principal and interest are theoretically determined. Thus, by the annuity method, if $100,000 is to be issued at 5 per cent annually and retired in 20 years, the annual amount of interest and principal is at once determined to be approximately $8,000.

[1] Cf. Appendix D, pages 91 to 115, for details of such schedules.

For the same bond issue under the serial plan, the total annual payment varies because the interest varies, but each yearly payment of interest and principal is nevertheless fixed.

Under the sinking-fund plan the annual payment necessary for principal and interest is theoretically constant, but it depends upon the interest realized upon the sinking fund. It is not safe, as a rule, to estimate this interest at more than 3½ per cent. Then for a $100,000 20-year loan, with annual interest on the sinking fund, the total annual payment would be $8,536.11. If the sinking fund could earn the rate of interest which is paid upon the loan there would be no advantage in expense to the community in the annuity or the serial bond over the sinking-fund bond. There is given in Table 13 the total mill tax on $1 to retire a bond issue of $100,000 by the sinking fund or the annuity plan.

TABLE 13.—*Annual mill tax on $1 for interest and retirement on a bond issue of $100,000, at 5 per cent annual interest, for terms of 10 and 20 years.*

Valuation.	Mill tax.							
	10 years.				20 years.			
	Sinking-fund plan.[1]			Annuity plan.[2]	Sinking-fund plan.[1]			Annuity plan.[2]
	3 per cent.	3½ per cent.	4 per cent.		3 per cent.	3½ per cent.	4 per cent.	
$1,000,000	13.723	13.524	13.329	12.950	8.722	8.536	8.358	8.024
1,500,000	9.149	9.016	8.886	8.634	5.814	5.691	5.572	5.350
2,000,000	6.861	6.762	6.665	6.475	4.361	4.268	4.179	4.012
2,500,000	5.489	5.410	5.332	5.180	3.489	3.414	3.343	3.210
3,000,000	4.574	4.508	4.443	4.317	2.907	2.845	2.786	2.675
3,500,000	3.921	3.864	3.808	3.700	2.492	2.439	2.388	2.293
4,000,000	3.431	3.381	3.332	3.238	2.180	2.134	2.090	2.006
4,500,000	3.050	3.005	2.962	2.878	1.938	1.897	1.857	1.783
5,000,000	2.745	2.705	2.666	2.590	1.744	1.707	1.672	1.605
5,500,000	2.495	2.459	2.423	2.355	1.586	1.552	1.520	1.459
6,000,000	2.287	2.254	2.222	2.158	1.454	1.423	1.393	1.337
6,500,000	2.111	2.081	2.051	1.992	1.342	1.313	1.286	1.235
7,000,000	1.960	1.932	1.904	1.850	1.246	1.219	1.194	1.146
7,500,000	1.830	1.803	1.777	1.727	1.163	1.138	1.114	1.070
8,000,000	1.715	1.691	1.666	1.619	1.090	1.067	1.045	1.003
8,500,000	1.614	1.591	1.568	1.524	1.026	1.004	.983	.944
9,000,000	1.525	1.503	1.481	1.439	.969	.948	.929	.892
9,500,000	1.445	1.424	1.403	1.363	.918	.899	.880	.845
10,000,000	1.372	1.352	1.333	1.295	.872	.854	.836	.802

[1] With interest compounded annually.
[2] The tax for the serial plan is slightly less, but varies from year to year.

It is quite probable that so many 30-year bonds are issued in order to take advantage of the fact that bonds of that term result in a low annual charge for interest and sinking fund. It will be seen from Table 14 that very little advantage is gained by fixing the term of a bond longer than 30 years. The annual charge decreases very slowly from that point, whereas the total charge increases rapidly.

TABLE 14.—*Annual and total costs of a loan of $100,000 for varying periods, with sinking fund to draw 3½ per cent interest, compounded annually.*

Term in years.	Annual interest on bonds.			
	4 per cent.		5 per cent.	
	Total annual payment, interest, and sinking fund.	Total cost of loan.	Total annual payment, interest, and sinking fund.	Total cost of loan.
5	$22,648	$113,241	$23,648	$118,241
10	12,524	125,241	13,524	135,241
15	9,183	137,738	10,183	152,738
20	7,536	150,722	8,536	170,722
25	6,567	164,185	7,567	189,185
30	5,937	178,114	6,937	208,114
35	5,500	192,494	6,500	227,494
40	5,183	207,309	6,183	247,309
45	4,945	222,540	5,945	267,540
50	4,763	238,169	5,763	288,169

The same facts are presented in the diagram of Plate III, figure 1. The curves of annual cost of interest and retirement fall very slowly after the 30-year point.

It is an unfortunate fact that most highways do not have a life of 30 years, and it is now quite evident that the life of the highway and not the apparent economic term of the bond should determine the length of the loan. Many miles of natural soil roads are annually built by 30-year bond issues. There is usually no provision for repair and maintenance charges, and little business organization in the county road system. This practice is financially dangerous. No gravel road surface can last 30 years,[1] and apparently the only road surfaces for which a 30-year life is recorded are surfaces of far more expensive construction than are usually built under the bond issues reported to the Office of Public Roads.

There is a further advantage in the annuity or serial bond for highway construction, because it is more likely under such a bond that the road surface will be paid for before it is entirely worn out. If an annuity or serial bond begins to mature immediately, this is not considered a serious objection among bankers. These types of bonds are particularly adapted for financing operations which by their very nature involve a wasting of the property. A highway is in part a wasting property and it is desirable to have established a margin of safety in highway financing. Railroads frequently issue serial equipment bonds for a period of 10 years with which to purchase rolling stock. The amount of bonds retired annually is carefully adjusted so that the retirement is faster than the depreciation of the rolling stock. The difference between the outstanding bonds and the value of the equipment in any year is the margin of safety.

[1] Massachusetts in 1912 reduced the term of State highway bonds from 30 to 15 years. Wisconsin passed a law, effective in 1913, providing that counties may issue 5 per cent bonds for State highways for periods not to exceed 10 years. The bonds must be serial bonds, with interest and redemption fund to be raised by direct taxation.

From the nature of the annuity or the serial form of highway bonds it is never necessary to issue new or refunding bonds at the end of the term. Both of these types of bonds have the advantage that they accomplish with one financial operation all that the sinking-fund type of bond can accomplish. The main advantage, however, of both types of bonds is that the community saves more money than under the sinking-fund plan because it avoids paying a higher rate on borrowed money than it can obtain on money that it loans.

Highway bonds are seldom sold at par. Not infrequently they command a slight premium; that is to say, they are sold at an advance over the par value. In nearly every State the law provides that municipal bonds shall not be sold at less than par.[1] When the purchaser pays a premium for a 5 per cent highway bond it will yield less than 5 per cent. To enable investors to determine quickly the net rate of yield from a bond purchased at a premium or at a discount, tables known as bond tables have been calculated. In Appendix D is presented a short bond table of this kind (Table 37). From this table the net yield of a bond with a nominal rate of interest of from 3 to 6 per cent, payable semiannually and for varying terms, may be calculated for various prices. Thus a 5 per cent 15-year highway bond purchased at 103.20, or with a premium of 3.20 per cent, will be found to yield the purchaser 4.70 per cent on his investment.[2] Such tables are of more important interest to the purchaser than to the municipality offering the bonds, but they are necessary for the intelligent direction of the bond issue.

In calculating the price to be paid for serial bonds, it is customary to treat each series separately and to find the price that yields the given net rate by adding the separate prices. Some formulas will be found, however, in Appendix D which considerably shorten the labor of calculating the price to be paid for serial bonds and the labor of related calculations.

Special form of annuity bond.—In the operation of the annuity bond both interest and principal are discharged by a series of equal installments, usually semiannual. Each installment contains interest on the bonds outstanding at the beginning of the interval and the balance is applied to retire the bonds. The effect of this method is to diminish steadily the investment of the purchaser. If, however, the borrower should arrange to set aside periodically in a sinking fund a fixed sum *in excess of the periodic interest on the entire issue*, the effect would be to leave the total investment of the purchaser undisturbed until the sinking fund had accumulated to the amount of the loan. When the excess of the periodic installment over the required interest is arbitrarily selected and accumulates at a given rate of

[1] Massachusetts requires the premium to be deposited in the sinking fund. To avoid paying par value for the bonds, bidders frequently bid par or above par and require an allowance for attorney's fees and expenses.

[2] Cf. Appendix D, page 129.

interest, the term of the bond is thereby absolutely fixed. A simple way to accomplish this result is to add to the nominal interest rate which the bonds pay a percentage of the principal to be set aside in a sinking fund to retire the bonds. There is produced thus a new nominal rate. Since both interest and principal are discharged by the periodical payment of interest or dividends at the new nominal rate, an issue of this character may be described as a special form of annuity bond.

Table 15 shows the resulting terms in years of a bond issue for $1,000,000 where from 1½ to one-half per cent of the principal is set aside semiannually in a sinking fund which draws 3 per cent compounded semiannually. The original interest rate on the bonds is assumed to be 3 per cent, payable semiannually, and the new increased nominal rate varies then from 6 to 4 per cent. The last column shows the total cost to the borrower for the loan of $1,000,000 under this method.

TABLE 15.—*Necessary terms and total costs of a bond issue of $1,000,000 at 3 per cent, payable semiannually, when retired by various arbitrary fractions of the principal set aside and compounded semiannually.*

Applied semiannually to sinking fund to retire bond issue.	New increased interest rate on original 3% bonds.	Term of bonds.	Total cost to borrower.
Per cent. of loan.	*Per cent.*	*Years.*	*Dollars.*
1½	6	23½	1,410,000
1⅜	5¾	25	1,437,500
1¼	5½	26½	1,457,500
1⅛	5¼	28½	1,496,250
1	5	31	1,550,000
⅞	4¾	34	1,615,000
¾	4½	37	1,665,000
⅝	4¼	41½	1,763,750
½	4	47	1,880,000
½	4	50	2,000,000

The progress of the accumulation of the semiannual sinking fund under the plan here outlined is shown for varying retirement rates in Table 17. It is possible so to determine the rate of retirement that the resulting term of the bonds is integral instead of fractional. The increased nominal rates for 3 per cent bonds to retire in varying integral terms is as follows:[1]

TABLE 16.—*Equivalent nominal rates for retiring 3 per cent bonds in varying terms.*

	Per cent.		Per cent.
10 years	11. 649148	30 years	5. 078686
20 years	6. 685420	40 years	4. 309664
25 years	5. 714336	50 years	3. 874114

[1] This rate per cent is determined by the formula:

$$\text{Rate per cent} = 3 + 200/S_{\overline{2n}|}$$

where n is the number of years $S_{\overline{2n}|}$ is determined from Table 32, Appendix D, at the rate 1½%.

TABLE 17.—*Accumulations at 3 per cent, convertible semiannually, of a semiannual sinking fund to extinguish a loan of $1,000,000.*

New increased nominal rate on original 3% bonds.	4 per cent.	4¼ per cent.	4½ per cent.	4¾ per cent.	5 per cent.	5¼ per cent.	5½ per cent.	5¾ per cent.	6 per cent.
	Percentage which the semiannual sinking-fund payment bears to the loan.								
Years.	½ per cent.	⅝ per cent.	¾ per cent.	⅞ per cent.	1 per cent.	1⅛ per cent.	1¼ per cent.	1⅜ per cent.	1½ per cent.
0.5	$5,000.00	$6,250.00	$7,500.00	$8,750.00	$10,000.00	$11,250.00	$12,500.00	$13,750.00	$15,000.00
1.0	10,075.00	12,593.75	15,112.50	17,631.25	20,150.00	22,668.75	25,187.50	27,706.25	30,225.00
1.5	15,226.13	19,032.66	22,839.19	26,645.72	30,452.25	34,258.78	38,065.31	41,871.84	45,678.38
2.0	20,454.52	25,568.15	30,681.78	35,795.40	40,909.03	46,022.66	51,136.29	56,249.92	61,363.55
5.0	53,513.61	66,892.01	80,270.41	93,648.81	107,027.22	120,405.62	133,784.02	147,162.42	160,540.83
10.0	115,618.34	144,522.92	173,427.50	202,332.09	231,236.67	260,141.25	289,045.84	317,950.42	346,855.01
15.0	187,693.41	234,616.76	281,540.11	328,463.46	375,386.81	422,310.17	469,233.52	516,156.87	563,080.22
20.0	271,339.47	339,174.34	407,009.20	474,844.07	542,678.94	610,513.81	678,348.67	746,183.54	814,018.41
23.0	327,842.07	409,802.59	491,763.10	573,723.62	655,684.14	737,644.66	819,605.17	901,565.69	983,526.21
23.5	337,759.70	422,199.63	506,639.55	591,079.48	675,519.40	759,959.33	844,399.25	928,839.18	1,013,279.10
24.5	358,043.49	447,554.36	537,065.23	626,576.10	716,086.98	805,597.85	895,108.72	984,619.59	
25.0	368,414.14	460,517.68	552,621.21	644,724.75	736,828.28	828,931.82	921,035.35	1,013,138.89	
26.0	389,624.46	487,030.57	584,436.69	681,842.80	779,248.92	876,655.03	974,061.14		
26.5	400,468.82	500,586.03	600,703.24	700,820.44	800,937.65	901,054.86	1,001,172.06		
28.0	433,987.71	542,484.64	650,981.57	759,478.50	867,975.43	976,472.36			
28.5	445,497.53	556,871.91	668,246.30	779,620.68	890,995.06	1,002,369.44			
30.0	481,073.26	601,341.57	721,609.89	841,878.20	962,146.52				
30.5	493,289.36	616,611.70	739,934.04	863,256.38	986,578.71				
31.0	505,688.70	632,110.87	758,533.05	884,955.22	1,011,377.40				
33.5	570,531.68	713,164.60	855,797.52	998,430.44					
34.0	584,089.65	730,112.07	876,134.48	1,022,156.90					
35.0	611,818.76	764,773.46	917,728.15						
36.5	654,991.78	818,739.72	982,487.67						
37.0	669,816.65	837,270.82	1,004,724.98						
40.0	763,554.26	954,442.83							
41.0	796,707.69	995,884.61							
41.5	813,658.31	1,017,072.88							
45.0	939,649.50								
46.5	997,797.29								
47.0	1,017,764.25								
50.0	1,144,015.22								

The details of advertising and selling highway bonds are frequently prescribed by law. Bids from bond houses are always made conditioned on an investigation of the validity of all proceedings leading to the issue. The attorneys for the bidders will require from the municipality certified copies of all papers concerning the transaction. There frequently is much variation in the form of the bids for a single issue. The items of denomination of the bonds, options on delivery, portion of the issue bid for, deposit of the money in stipulated banks, and items of less importance are often written into the bids.

TOTAL COST OF HIGHWAYS.

Charges included in total cost.—The first cost of construction is not the total cost of a highway. It is becoming customary to consider the cost of highways for a period of years.[1] This view of highway costs is important in the construction of highways with borrowed money. Municipal or county bonds are invariably issued for a definite term or period, and it is desirable, therefore, to know the total cost to a community during the life of the bond. Undoubtedly the best financial policy is to restrict the term of the highway bond to the probable useful life of the original type of road under actual conditions.

There is considerable difference of opinion among engineers and highway officials as to what constitutes the total cost of a highway during a given period of years. Questions arise over the interest charge on the original cost, the annual payments to amortize or retire the loan, the depreciation charge, and the repair and maintenance charge. Evidently if a repair and maintenance charge is made sufficient to maintain the road *absolutely* for an indefinite period, a depreciation charge has no place in the estimate of total annual cost. It is also apparent that total and annual costs for the loan can be made to vary at will by changing the period of the loan, i. e., the term of the bond. To make the problem more definite, it is desirable to assume, first, that the highway loan is a terminable loan and for a period not greater than the period for which the road will continue to serve with the original type of surface, grade, and alignment; and, second, that there is charged as the total cost of the road for that period all money paid by the community for that road in the form of taxes.

Although the cost of resurfacing a road or extraordinary repairs is a cost which occurs only at intervals, it is a safe and conservative plan to make an annual charge for all such work. As an example, if a water-bound macadam road is built at a cost of $8,000 per mile

[1] Cf., for example, the report of the Cambridge (Mass.) Paving Commission, June, 1911, and the 1909 Report of Public Work in Cuyahoga County, Ohio, p. 21.

with money borrowed at 5 per cent for 15 years and retired by a sinking fund, there would result the following annual expense to the taxpayers for each mile for 15 years: Interest on $8,000 at 5 per cent, $400; annual sinking fund to retire $8,000 in 15 years, at 3½ per cent interest compounded semiannually, $413.66;[1] cost of annual maintenance, $125; annual cost of periodic[2] resurfacing, $400—making a total annual cost of $1,338.66. By the annuity bond plan, the expenses would be: Annual repayments of interest and principal,[3] $770.74; cost of annual maintenance, $125; annual cost of periodic[2] resurfacing, $400—making a total annual cost of $1,295.74.

At the end of 15 years the interest and redemption charges cease, and if resurfacing is carried out as planned the surface is but two years old and the community has a property the permanent value of which represents at least 62 per cent of the original cost, or $4,960, exclusive of the surface, and an accumulation of $800 toward resurfacing. If the road is to continue in its original form, the annual charge for repairs and maintenance will probably increase because of increased traffic. If the annual payment of principal is reduced by extending the period of the loan, there is danger that a new loan will be necessary for more expensive construction to meet the increasing traffic before the original loan is retired. Moreover, the decrease in annual payments of interest and principal is not inversely as the increase in the period of the loan. A 30-year 5 per cent annuity bond would require an annual payment of $520.41 per mile on the $8,000 macadam road above cited. (See Table 36 and Pl. III, fig. 1.)

If the same method of estimating the annual cost is used for each type of road considered, the relative total cost of the various types may be computed fairly and without confusion. If a highway were built from cash in the public treasury it would theoretically still be necessary to include in the annual cost of such a highway the interest on the first cost of construction at a rate which the municipality or county could obtain by investment of its funds. The question of how long such interest should run has never been determined.[4]

In estimating the total cost of a highway for a series of years the cost of repair and maintenance is the item most frequently neglected.[5] The cost of the sinking fund or the charge for bond redemption is also sometimes forgotten. There are now outstanding bonds for highway construction where no provision has been made to retire them, although the bonds have been issued for a definite term.

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[1] Use Table 6, p. 15.

[2] At intervals of 6.5 years, at $2,600 per mile, or 29.5 cents per square yard for a 15-foot road; no allowance of interest is made; for discussion of this point, see p. 13.

[3] See Table 36, Appendix D.

[4] Theoretically interest would run until improved road had paid for itself by saving to community.

[5] In one county of Virginia, after public highways had been constructed from the proceeds of a bond issue, the county established tollgates upon the highways in order to raise revenue for their maintenance.

Financing maintenance.—It is undoubtedly necessary, in general, to establish a direct tax for annual repair and maintenance for bond-built highways.[1] When highway bonds are issued it should be distinctly understood that there will be (besides the tax for interest and retirement) within a few years an additional tax for repair and maintenance, if the regular road tax within the county, as is most often likely, is not already sufficient to repair and maintain the new roads. This repair and maintenance charge is inevitable and, since the earning power of the road in reducing hauling costs tends to increase with the degree of maintenance, it is sound business to face the repair and maintenance charges in the beginning.

Comparisons of total costs.—When the more expensive types of highways are to be built by the proceeds of a bond issue, especially under increasing traffic, a question may fairly arise as to the relative portions of the total cost for a series of years, which should be devoted to repair and maintenance and to first construction and interest. As Table 5 shows, the cost of the hard highway surface constitutes, for standard types of construction, the largest percentage of total costs.

Up to a certain point, when the cost of the surface is increased, the cost per mile of maintenance correspondingly increases, but not usually the cost per unit of traffic. It costs more per mile to repair and maintain an ordinary macadam road, for example, than it does to repair and maintain a gravel road, and the cost per mile of repair and maintenance for bituminous-macadam roads is greater than for ordinary macadam roads. The costs of repair and maintenance of the best-built brick and concrete roads are apparently very low, and would, therefore, not follow the above rule.

The total necessary cost of a highway for a series of years can be determined only approximately and only after a study of the character and volume of traffic and a comparison of the total probable costs for the kinds of surface adapted to the traffic. It may not be economy to build a road of cheap first cost and high maintenance charges. If exact figures were available, accurate comparisons of different surfaces would be simple, but many items are still lacking. It is not known how long a concrete road will wear or what it will cost to renew it, especially if it has to be broken up and removed. The life of bituminous-macadam roads has not yet been fully determined, nor has the life of the best modern vitrified brick pavement. Absolute maintenance[2] on most pavements can seldom be continuous. Repairs or resurfacing operations will be needed at intervals which are as yet imperfectly determined.

[1] Cf. Act of September, 1913, by Legislature of Tennessee, which establishes a maintenance tax of 2 per cent of all highway bonds.

[2] See Bulletin No. 48 of the Office of Public Roads, p. 8.

If it is assumed that a 15-foot bituminous-macadam road costs $10,500 a mile, and the corresponding 15-foot brick road $18,500 a mile, with annual (absolute) maintenance for the bituminous road at $600 per year and strict maintenance [1] for the brick road $300 per year, the necessary items for the total cost for 20 years may be stated as follows:

Bituminous-macadam:	
Cost of construction ($10,500) under 5 per cent serial bond with interest for 20 years [2]	$16,012.50
Cost of annual repair and maintenance ($600) for 20 years	12,000.00
Total cost for 20 years	28,012.50
Brick:	
Cost of construction ($18,500) under 5 per cent serial bond with interest for 20 years [2]	$28,212.50
Cost of annual repair and maintenance ($300) for 20 years	6,000.00
Total cost for 20 years	34,212.50

On the assumption made there is not as much difference in the total costs of the two road surfaces as would appear from the first costs. It is not known that $600 per mile per year will absolutely maintain a bituminous-macadam road nor that $300 per mile per year will strictly maintain a brick road, and the relative value of the two road surfaces at the end of the 20-year term is still to be determined.

The above analysis indicates a method of estimating the total cost of roads and of required bond issues. The total cost of a 15-foot concrete road, for example, may be compared with the above total costs, assuming a construction cost of about $1.35 per square yard or $11,880 a mile and an equivalent annual repair and maintenance charge between that of brick and bituminous-macadam.

EXPEDIENCY OF ISSUING HIGHWAY BONDS.

Legal restrictions on bond issues.—Nearly all States restrict the total amount of municipal bonds which may be issued to a fixed percentage of the assessed valuation. In other cases there are legal restrictions governing the amount of taxes which may be raised for highway purposes. These are examples of legal restrictions which must be clearly understood before the issue is made. The question frequently arises regarding the authority of the districts of a county to issue bonds. In a number of States the law allows the creation of highway districts or the issuance of bonds by the legal subdivisions of a county. Care must be exercised to determine to what officers the authority for such issues belongs. Instances have arisen where district road boards have undertaken the issue of bonds legally voted, but where the law provided that the county authorities and not the district authorities must issue the bonds.

[1] See Bulletin No. 48 of the Office of Public Roads, p. 8.

[2] Use Table 11, p. 18.

In nearly all States county bonds or district bonds of any kind must be authorized by a majority, or a two-thirds vote, of either the entire county or of the district.

Advantage of bond issues.—The issuance of highway bonds is essentially a method of capitalizing the resources of a community for the purpose of creating improved highways. The fundamental advantage of the bond plan is the construction of a good system of roads at once, but there are secondary advantages in building roads in long stretches and in the planning of the maintenance of such roads.

The question is not merely whether a community shall incur a debt; it is also a question as to whether the maximum economic efficiency and the full development of the public wealth will be best promoted by using public credit.

There is shown in Plate III, figure 2 the relation between the volume of traffic in ton-miles, reduction in hauling cost in cents per ton-mile, and the annual cost per $1,000 of a 20-year bond under the annuity plan. A mile of road sustaining 3,000 tons of travel per year, for example, would pay interest and retirement on $1,000 in 4 per cent bonds if the cost of hauling were reduced about 2.4 cents per ton-mile.

Emphasis has been placed in this publication on the strictly measurable economic benefits to a community from road improvement. There are many additional economic benefits and very great social benefits which are not readily measured. Increased school and church attendance is shown in repeated instances to be an immediate consequence of better roads.[1] The general stimulus to business is difficult to evaluate. It is evident, however, that business and professional men of all classes are among the first to be benefited. This is especially true of physicians. The cost of upkeep of automobiles, particularly of tires, is becoming yearly a large item and the road condition is a most serious factor for the automobilist and the users of motor trucks.

It should be understood at the outset that the question of debt itself is relatively less important than the question of sound planning and good management of the loan. The very presence of the improved road system increases the value of the county property and therefore the resources supporting the loan. It is a well-established business principle that extension of credit within safe limits is necessary for maximum results. The financing of all private enterprises by bond issues has increased very greatly. In 1908 statistics show that, during the preceding decade, bonds were issued as a method of capitalizing public and private enterprises at the rate of $583,000,000 annually.

[1] Cf. Farmers' Bulletin No. 505, "The Benefits of Improved Roads." This bulletin may be obtained from the Secretary of the U. S. Department of Agriculture.

Failure of bond issues.—Instances are not lacking where bond issues for highway purposes have proved failures. These instances are invariably due to mismanagement rather than to defective principle. Where counties have issued highway bonds the proceeds of which have been spent to construct temporary road surfaces on unimproved grades and without proper drainage, failure has necessarily resulted. There are on record in the Office of Public Roads instances where so-called macadam roads have been built with bond money by simply dumping broken stone at the wrong time of the year on muddy road surfaces without grades or alignments and without rolling or binding. (Cf. Pl. I, fig. 2.)

A typical method of mismanagement is to distribute the funds equally on all the roads in the county or district issuing the bonds. Recently in a southern State $40,000 was distributed equally over nearly 90 miles of highway in a certain district. After deducting necessary overhead expenses this sum was equivalent to about $400 per mile. Obviously no permanent results could be obtained from such a distribution. In another county, where heavy rains and severe winters could not fail to make the roads nearly impassable with the superficial construction adopted, bonds were issued to the amount of $300,000. The money was devoted to light grading on an excessive mileage without any attempt at surfacing.

Through a misunderstanding of the essential principles underlying the establishment of a proper county road system, conflicts of interest sometimes arise which cause the failure of the bond issue plan. The location of the roads to be improved should not be determined by argument, but upon sound engineering and economic principles. Before a community votes to issue bonds for highways it is necessary to understand thoroughly what roads are to be improved and the approximate cost of their construction and maintenance. Too frequently ill-advised locations are adopted.

Need for highway engineers.—Highway plans for bond issues require expert skill and professional service. Before the amount of bonds is determined, a thorough study of the needs of the county should be made and careful maps of the proposed highway system should be prepared. The sum to be issued should not be fixed until it is reasonably known what it will accomplish. It is customary for many counties to appoint a commission of business men under whose jurisdiction the bond money is expended. In other cases the county supervisor or county commissioner has the direction of expenditures. The best results have always followed where such commissions or county boards have secured the services of a highway engineer.

Guided by the costly experience of many communities, it is now becoming common for counties to adopt this plan. In all engineering construction it is customary to allow a certain percentage of the cost

for engineering and supervision. There is no reason why highway building should be made an exception to this rule. At least 5 per cent of the bond issue may well be set aside for engineering and supervision alone. Money spent to hire a competent engineer [1] to make preliminary investigations before bonds are issued and to plan and supervise construction will be well spent. It is not uncommon to find counties that will repeatedly postpone the sale of bonds in order to obtain an increase of 1 per cent in a bid for $100,000 or less and then proceed to construct the roads in a most haphazard and ill-planned manner.

Benefit to nonabutting property owners.—In planning the highway system or the main market roads, as mentioned above, it will be found necessary to omit many roads the improvement of which is greatly desired by abutting landowners. The fact that such property holders must pay a tax for the bond issue is only an apparent injustice, for if the highway system is well planned the entire county will feel the benefits of the improvement. As a rule, main market roads reach the majority of producing areas, and when they are improved all land values tend to increase.

The fact that cities and larger towns are frequently taxed for bond issues to build highways outside of their own limits is sometimes made a point of debate in bond elections. It is argued that because a large part of the county wealth is within the corporate limit of such cities and towns, highway bond money should also be used to construct their streets. It is even urged that the expenditure should be made proportionate to the assessed valuation within the city limits. If the proceeds of highway bond issues were distributed in this way their purpose in many cases would be defeated. The primary object of the county highway bond issue is to build county market roads and not to improve city streets, although a high percentage of the assessed valuation may be city property.[2] It is now known that the expenditure of city taxes on country roads is a sound principle and that it is one of the best features of State aid for highways. In Massachusetts the city of Boston pays possibly 40 per cent of the total State highway fund, but not a mile of State-aid highway has been built within its limits. New York City also pays about 60 per cent of the cost of the State highway bonds. Some State laws prohibit the expenditure of proceeds of State highway bonds within corporate limits of cities or towns. The improvement of market roads results in improved marketing conditions which benefit the city. Most cities are essentially dependent upon the surrounding country for their prosperity and development. The development of suburban property for resi-

[1] In the general bond act of September, 1913, by the State of Tennessee the employment of an engineer by the county commissioner is made mandatory. In Virginia the law provides that counties building roads under a bond issue shall employ an engineer either appointed or approved by the State highway commissioner.

[2] For arguments concerning the benefits of good roads cf. Farmers' Bulletin No. 505.

dence purposes is also dependent upon highway conditions and it is becoming evident yearly that whatever makes for an increase in rural population must be encouraged. Since the introduction of motor traffic, country highways have been used to an increasing extent by city residents. In fact, the cost of maintaining many country highways has been greatly increased by the presence of city-owned motor vehicles. The general advance in facilities for doing country business from town headquarters when roads are improved is no inconsiderable factor in the commercial life of the community.

Examples of county bond-built roads.—The Office of Public Roads during the past four years has undertaken a detailed study of economic conditions in several counties which have issued bonds for highway construction. These studies have involved field work each year for from three to five years in the several counties. The detailed results of these studies are embodied in reports which are now on file in the office. Sufficient data have been gathered to emphasize and illustrate many points brought out by the discussion in the present bulletin.

The locations of the studies were Dinwiddie, Lee, Spotsylvania, and Wise Counties, Va.; Dallas County, Ala.; Lauderdale County, Miss.; Manatee County, Fla.; and Franklin County, N. Y. Although no special field studies were made in Wayne County, Mich., statistics for that county have also been compiled.

TABLE 18.—*Financial items.*

County and State.	Highway bonds.	Term in years.	Nominal interest.	Valuation year of issue.	Per cent of valuation in highway bonds.
Dinwiddie, Va	$105,000	20 and 30	5 and 6	$3,661,897	2.84
Lee, Va	440,000	Serial.	5 and 5½	3,014,405	14.59
Spotsylvania, Va	183,000	30	5	[1] 1,962,956	9.32
Wise, Va	960,000	30	5	11,011,780	8.71
Manatee, Fla	250,000	30	5	2,450,000	10.20
Dallas, Ala	410,000	30	5	13,330,355	3.08
Lauderdale, Miss	350,000	30	5 and 5½	16,443,301	2.13
Franklin, N. Y	500,000	60	4½ and 5	12,293,434	4.07
Wayne, Mich	2,000,000	Serial.	4	467,400,635	.43

[1] 1913.

The total amount of bonds issued by these counties during the years 1900 to 1913, inclusive, was $5,188,000, and with the exception of Lee and Wayne Counties, where the bonds were issued under the serial plan, and Franklin County, N. Y., where they are to run for 60 years, they are straight terminable bonds for 30 years. Table 18 summarizes the financial items for each county.

In some instances no preparation has been made for establishing a sinking fund to retire bonds at maturity. In several of these counties there is no provision whatever for systematic maintenance. In Virginia the State law provides that State aid allotted to counties may be used for the redemption of bond issues where the roads are built

in accordance with the requirements of the State highway commissioner and under the supervision of his engineers. In four counties in Virginia the roads are built under this plan. In Dallas County, Ala., the construction of bond-built roads was in charge of the four district commissioners and the probate judge. In Manatee County, Fla., the roads were built under the supervision of the five district county commissioners. In Lauderdale County, Miss., the county supervisors appointed a road commission of three members to construct the roads under the bond issue, and a highway engineer was employed and all work done by contract. In Franklin County, N. Y., the roads were constructed by the county road commissioners and the county superintendent of roads. In Wayne County, Mich., the roads were built by the board of county road commissioners, appointed by the county board of supervisors.

The following table shows the mileage and cost of roads constructed in each county:

TABLE 19.—*Mileage and cost of roads in nine counties where bonds were issued.*

County and State.	Miles built.	Per cent of total mileage in county.	Kind.	Average cost per mile.
Dallas, Ala.	197	19.0	Gravel	$3,700
			Sand-clay	1,650
Manatee, Fla.	64	12.8	Macadam	4,250
			Shell	2,400
Lauderdale, Miss.	84	10.5	Macadam [1]	6,500
			Sand-clay	1,900
Spotsylvania, Va.	41	10.0	Gravel and sand-clay	2,200
Dinwiddie, Va.	125	25.0	Gravel and top soil	1,689
Franklin, N. Y.	124	9.0	Gravel	2,200
			Macadam	3,250
Lee, Va.	84	18.2	do	7,400
			Earth graded	5,000
Wise, Va.	131	43.7	Macadam	8,000
			Earth graded	5,300
Wayne, Mich.	83.5	5.8	Concrete [2]	13,200

[1] Surface treated with petroleum asphalt. [2] Eighty miles.

In no one of these counties, with the exception of Detroit, in Wayne County, Mich., were there any large cities. The roads were, for the most part, constructed as market roads radiating from the main market towns in the county, as may be seen from the maps of Plates IV, VI, and IX. The economic benefits accruing to the several counties from the improvement of the roads are already apparent, and in several instances have been extraordinary. (Cf. Pls. V, VII, and VIII.)

In Dallas County, Ala., and Lauderdale County, Miss., cotton is the principal crop, although in the latter county lumber is also an important commodity. Lumber and ties form, also, the principal commodity hauled in Spotsylvania County, Va. In Dinwiddie County the principal commodities are tobacco, peanuts, and hay; in Lee County farm and dairy products, hardwood, lumber, and coal; and in Franklin County, N. Y., milk and miscellaneous farm products.

In Manatee County, Fla., the principal crops are citrous fruits and early vegetables, which are shipped north. In Wayne County, Mich., the city of Detroit is the center of the road system and attracts a very large volume of miscellaneous traffic. The estimated annual tonnage hauled over the bond-built highways in almost every instance is sufficiently large to produce, by an assumed reduction of a few cents per ton-mile in cost, a sufficient operating income to cancel the annual interest and retirement fund required by the bonds. The relation of these items is summarized in the following table:

TABLE 20.—*Summary of relation between bond requirements and reduced cost of hauling.*

County and State.	Total annual ton-miles estimated at minimum.	Approximate cost of annual interest and redemption on highway bonds.	Equivalent necessary reduction (cents per ton-mile).
Dallas, Ala	600,000	$28,333	4.7
Manatee, Fla	[1] 200,000	17,342	8.7
Lauderdale, Miss	720,000	24,530	3.4
Spotsylvania, Va	574,720	12,695	2.2
Dinwiddie, Va	212,500	8,633	4.1
Franklin, N. Y	201,544	25,544	12.6
Wayne, Mich	4,353,966	[2] 179,882	4.1

[1] Rough estimate. [2] Equivalent for annuity bond.

The increases in the value of land adjacent to the improved roads are especially noteworthy. In Manatee County, Fla., land increased in value $20 per acre from 1911 to 1912, and a mile away from the road the increase was $10 per acre. In Spotsylvania County, Va., land which formerly sold at an average of $24.74 per acre changed hands within three years at an average of $44.74. In Dinwiddie County, land between 5 and 10 miles from Petersburg advanced on an average from $15.25 to $30 in about 15 instances, and land 10 miles from town increased, on an average in 16 instances, $16.32 an acre. On eight pieces of land in Franklin County, selected at random, there was an increase in value of 27.8 per cent after the improved roads were built, and in Lee County, Va., land advanced 25 per cent.

The construction of the bond-built highways in several of the counties herein mentioned has been of decided benefit to school attendance. In Spotsylvania County one consolidated school replaces three one-room schools, and another consolidated school is planned. In Dinwiddie County school attendance increased 17½ per cent in one year on the improved roads, and several school wagons carrying 24 pupils each have been put in service. In Lee County school attendance along the improved roads shows an average of 71 per cent against 62 per cent along other roads. In Wise County several successful school consolidations have been effected since 1909. The Pole Bridge School in this county on the road from Coburn to Wise replaces four one-room schools.

APPENDIX A.

STATE HIGHWAY BONDS.

TABLE 21.—*Complete list of State highway bonds.*

State.	Year.	Amount (by years). Voted.	Amount (by years). Issued.	Rate (per cent).	Term (years).	How redeemed.
California	1910	[1] $18,000,000		4	50	$400,000 annually after July 1, 1917.
	1912		$2,000,000	4	50	
	1913		3,390,000	4	50	
Total		18,000,000	5,390,000			
Connecticut	1907	[2] 4,500,000	1,500,000	3½	22	$205,000 annually.
	1909		1,500,000			
	1911	[3] 3,000,000	2,000,000	4	25	$120,000 annually.
	1913	[3] 3,000,000	2,000,000	4	25	Do.
Total		10,500,000	[4] 7,000,000			
Idaho [5]	1905	50,000	50,000	4	30	Sinking fund.
	1907	18,000	18,000	4	20	Do.
	1909	22,000	22,000	4	10 and 20	Do.
	1911	136,000	136,000	4, 4½, 5	5, 6, 10, 20	Do.
	1912	29,000	29,000	4½ and 5	20	Do.
	1913	250,000	250,000	4	20	Do.
Total		505,000	505,000			
Maine [6]	1912	2,000,000				
	1913		300,000	4	40	$7,500 annually.
Total		2,000,000	300,000			
Maryland [7]	1908	5,000,000	500,000	3½	15	Sinking fund.
	1909		1,000,000	3½	15	Do.
	1910	[8] 1,000,000	1,000,000	3½ and 4	15	Do.
	1911		1,250,000	3½ and 4	15	Do.
	1912	[9] 3,170,000	2,250,000	(9)		Do.
	1913		2,646,000			
Total		9,170,000	8,646,000			
Massachusetts	1894	300,000	300,000	3½	26	Do.
	1895	400,000	400,000	3½	25	Do.
	1896	600,000	600,000	3½	24	Do.
	1897	800,000	700,000	3½	30	Do.
	1898	400,000	300,000	3	30	Do.
	1899	500,000	400,000	3	30	Do.
	1900	500,000	400,000	3	30	Do.
	1901	500,000	350,000	3	30	Do.
	1902	500,000	375,000	3 and 3½	30	Do.
	1903	2,250,000	400,000	3½	30	Do.
	1904		300,000	3½	28	Do.
	1905		250,000	3½	25	$10,000 annually.
	1906		300,000	3½	30	Do.

[1] *California.*—Proceeds of bond issue to be expended on a continuous and connected State highway system running north and south through the State, traversing the Sacramento and San Joaquin Valleys and along the Pacific coast, by the most direct and practicable routes, connecting the county seats of the several counties through which it passes, together with such branch roads as may be necessary to connect therewith the several county seats lying east and west of such State highway. No limitation on annual expenditure.

[2] *Connecticut.*—To be expended during the six fiscal years ending Sept. 30, 1913. Bonds to be paid in 22 annual installments by appropriation from general fund.

[3] $1,000,000 for improvement of public roads; $2,000,000 for improvement of trunk-line roads. The 1911 and 1913 bond issues mature in 1936, but may be redeemed by the State treasurer whenever and in such manner as he deems to be for the best interest of the State. They are not specifically known as road bonds; but the 1911 highway appropriation was specifically designated by the legislature to be from the proceeds of the $6,000,000 State issue of bonds. The 1913 appropriation is made from the treasury, while the treasurer is, in a special act, authorized and instructed to issue $4,000,000 additional bonds to meet the needs of the State.

[4] For trunk-line roads only.

[5] *Idaho.*—For various roads and bridges specified in the act authorizing each bond issue, except $200,000 in 1913, which is expended under State highway commission.

[6] *Maine.*—Not to exceed $2,000,000 shall be outstanding at any one time. To be expended in the construction of State highways, the whole cost to be paid by State, except where a town may desire the joint State-aid fund to be applied on State highway.

[7] *Maryland.*—For State roads.

[8] Not to exceed $250,000 to be issued in any one year, beginning Jan. 1, 1911.

[9] To be issued in amounts of not less than $500,000 at a time upon request of the State roads commission. Rate of interest to be fixed by the governor, the comptroller of the treasury, and the State treasurer.

TABLE 21.—*Complete list of State highway bonds*—Continued.

State.	Year.	Amount (by years). Voted.	Amount (by years). Issued.	Rate (per cent).	Term (years).	How redeemed.
Massachusetts	1907	$2,500,000	$360,000	3½	30	$12,000 annually.
	1908		495,000	3½	30	$16,500 annually.
	1909		380,000	3 and 3½	10–30	$220,000 deferred serial, 1920–1939.
	1910		285,000	3½	10–30	$180,000 deferred serial, 1920–1939.
	1911		310,000	3½	10–30	$200,000 deferred serial, 1921–1940.
	1912	5,000,000	435,000	3½	10–30	All but $175,000 deferred serial.
	1913	[1] 115,000	1,110,000	3½		Serial.
Total		14,365,000	8,450,000			
New Hampshire	1909	[2] 1,000,000				
	1910		250,000	3 and 3½		Deferred serial, 1914–1917.
	1911		250,000	3½		Deferred serial, 1917–1921.
	1912		250,000	3½		Deferred serial, 1921–1924.
	1913	[3] 300,000	[4] 250,000	3½		
Total		1,300,000	1,000,000			
New Mexico [5]	1912	500,000		4		
Total		500,000	([6])			
New York	1906	[7] 50,000,000				Sinking fund.
	1907		1,000,000	3	50	Do.
	1908		5,000,000	4	50	Do.
	1909		5,000,000	4	50	Do.
	1910		5,000,000	4	50	Do.
	1911		10,000,000	4	50	Do.
	1912	[8] 50,000,000	8,000,000	4	50	Do.
	1913		16,000,000	4½	50	Dated Sept. 1, 1913; sold Jan. 14, 1914.
			5,000,000	4½	50	
Total		100,000,000	55,000,000			
Rhode Island	1906	[9] 600,000		3	30	Sinking fund.
	1909	600,000		3½	30	Do.
	1912	[10] 600,000		4	30	Do.
Total		1,800,000	1,800,000			
Utah	1911	[11] 260,000		4	23	Deferred serial, 1922–1934.
Total		260,000	260,000			
Washington [12]	1911	190,000	125,000	4	12	Paid from State highway fund.
Total		190,000	125,000			
Totals		158,590,000	88,476,000			

[1] *Massachusetts.*—Authorized for special State roads by legislature, 1913.

[2] *New Hampshire.*—Not to exceed $250,000 to be issued in any one year, and the proceeds to be used exclusively for State aid in the construction of the three trunk lines to be designated by the governor and council from the Massachusetts State line in a northerly direction.

[3] To be used for State aid in constructing trunk-line highway to be designated by the governor and council.

[4] Not sold Dec. 1, 1913.

[5] *New Mexico.*—These bonds shall be in denominations of $1,000, numbered 1 to 500, the first 20 of which shall be payable on Jan. 1, 1919, and 20 of said bonds, in consecutive numerical order, shall be due and payable on July 1 annually thereafter until and including July 1, 1942. The proceeds are to be expended for the construction and maintenance of a system of State highways.

[6] Bonds not sold Dec. 31, 1913.

[7] *New York.*—These bonds were to be issued in two classes, to be known as A and B. Class A is coupon or registered, and redeemable from a State sinking fund, while Class B bonds were to be registered and redeemable from a redemption fund provided by the counties and towns wherein the proceeds thereof should be applied to the improvement of highways.

[8] The act of the legislature authorizing this issue of bonds was ratified and rendered operative by vote of the people at the general election, November, 1912. Of the proceeds, $20,000,000 shall be devoted to State highways, to be built at sole cost of the State, and $30,000,000 to county highways, to be built at joint expense of State and county.

[9] *Rhode Island.*—$200.000 to be issued before Jan. 1, 1907, and the balance on or before Jan. 1, 1908; the proceeds to be used in building a system of State roads under the direction of the State board of public roads.

[10] To be used for construction, reconstruction, and maintenance.

[11] *Utah.*—The proceeds to be divided equally among the counties of the State, exclusive of Salt Lake County, to be used in the construction and maintenance of State roads and bridges therein. Bonds dated July 1, 1911.

[12] *Washington.*—For purchase of bridge across the Columbia River at Wenatchee.

STATE BOND ISSUES DEFEATED.

Colorado.—The proposition to issue $10,000,000 in State bonds for roads was submitted to the people of Colorado at the general election in November, 1912, and was defeated. The proposition can not be again submitted to the people within a few years.

Ohio.—At the general election in November, 1912, there was submitted to a vote of the people of Ohio a proposition to issue $50,000,000 in State bonds to construct a system of intercounty highways. The vote on this proposition numbered about three-quarters of a million, and the bond issue was defeated by 2,017. One remarkable fact in connection with this vote was that the cities of the State gave substantial majorities for the bond issue, while the rural vote was substantially against it, and to such an extent as to overcome the city majority, although about 80 per cent of the taxes which would have been levied to take care of the interest and sinking fund of the bonds would have been paid by the cities.

Rhode Island.—On June 3, 1913, a special election was held in the State of Rhode Island on the issuance of $700,000 of State bonds for the purpose of completing a system of State roads. At this election only about 14 per cent of the voters of the State attended the polls, and the proposition was overwhelmingly defeated.

Pennsylvania.—On November 3, 1913, at a general election a proposed issue of $50,000,000 in highway bonds was defeated, although the proposition carried in Philadelphia and Pittsburgh.

APPENDIX B.

APPROXIMATE LISTS OF COUNTY AND DISTRICT HIGHWAY AND BRIDGE BONDS; TOWNSHIP HIGHWAY AND BRIDGE BONDS; COUNTY, DISTRICT, AND TOWNSHIP HIGHWAY AND BRIDGE BONDS VOTED IN 1912 AND 1913; COUNTIES, DISTRICTS, BEATS, AND TOWNSHIPS GIVING COMPLETE MILEAGE RETURNS OF ROADS BUILT UNDER BOND ISSUES; TOWNSHIPS AND TOWNS GIVING COMPLETE MILEAGE RETURNS OF ROADS BUILT UNDER BOND ISSUES; SUMMARY OF ALL HIGHWAY AND BRIDGE BONDS VOTED TO JANUARY 1, 1914.

TABLE 22.—*County and district highway and bridge bonds.*[1]

ALABAMA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total Amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Autauga	$65,000	30	5	Limestone	$135,000	30	4½
Blount	150,000	30	5	Madison	172,500	.....	5
Bullock	160,000	30	5	Marion	100,000	20	5
Butler	155,000	.....	.....	Marshall	130,000	30	5
Colbert	200,000	30–35	5	Mobile	500,000	20	5
Conecuh	200,000	.....	.....	Montgomery	850,000	.....	4½–5
Crenshaw	125,000	.....	.....	Morgan	240,000	30	5
Dallas[2]	410,000	30	5	Perry	126,000	30	5
Elmore	170,000	30	5	Pike	192,000	.....	4½
Escambia[3]	38,000	.....	5½	Russell	100,000	30	5
Hale	100,000	.....	.....	St. Clair	85,000	30	5
Jackson	250,000	.....	.....	Sumter	120,000	20	5
Jefferson	200,000	30	6–5–6				
Lawrence	123,000	30	6	Total	5,121,500	.....	.....
Lee	25,000	30	4½				

ARIZONA.

Apache	$30,000	.....	5	Maricopa—Con.			
Greenlee: Duncan[4]	16,000	.....	6	Special road district 2	$40,000	20	6
Maricopa:				Mohave	100,000	.....	5
Phoenix (city)[5]	60,000	20	5	Yuma	500,000	.....	.....
Mesa (city)[5]	2,000	20	5				
Special road district 1	30,000	([6])	6	Total	808,000	.....	.....
Special road district 1	30,000	20	6				

ARKANSAS.

Benton	$2,815	12	.....	Montgomery	$10,000	.....	.....
Crawford[3]	174,000	.....	.....	Sebastian: Ft. Smith[3]	600,000	.....	.....
Jefferson	45,500	13	6	Woodruff: District 1	30,000	20	6
Lee	151,000	.....	.....				
Lonoke	205,000	20	5	Total	1,218,315	.....	.....

[1] In 21 States highway and bridge bonds have also been issued by townships. See list following.
[2] Includes $60,000 of bridge bonds.
[3] Bridge bonds only.
[4] Bridge.
[5] To cover partial cost of improvement of Phoenix to Roosevelt Dam road.
[6] Serial.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

CALIFORNIA.

Counties	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Alpine[1]	$4,800		5	Riverside	$1,500,000		
Contra Costa	300,000			Sacramento[3]	825,000	[2] 40	4½
Fresno[1]	80,000		6	San Diego	1,250,000	40	4½
Glenn	450,000	([2])	5	San Joaquin	1,850,000	40	5
Humboldt	15,000	20	7–9	San Mateo	1,298,000	7–10–40	5
Kern	2,500,000	25	5	Santa Barbara	290,000	20	6
Lake	20,000		5	Tehama	3,000		6
Los Angeles	3,500,000	40	4½	Ventura[1]	275,000		5
Orange	1,370,000		5				
Plumas	100,000	10–25	4	Total	15,630,800		

COLORADO.

Counties.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Delta	$71,700		5
Garfield	28,000		6
San Miguel	35,000		6
Total	134,700		

DELAWARE.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Kent	$30,000	20	5	Districts 1–10	$50,000	5–11	4
New Castle	[4] 1,285,000	20–51	4–4½–5				
Sussex[1]	30,000	5–24	4½	Total	1,395,000		

FLORIDA.

Alachua	$40,000			Nassau	$180,000		
Bradford: Hampton	25,000	20	6	Orange	800,000	30	5
Clay	150,000			Palm Beach	345,000	30	4½
Columbia	40,000		6	Pasco	150,000	30	5
Dade	250,000	20	5	Pinellas	370,000	30	5
De Soto	250,000			Polk: Winterhaven	130,000		
Duval	1,050,000	25	5	Putnam	155,000		5
Franklin	20,000	20	4½	St. John	70,000		
Hernando	300,000	30	5	St. Lucie	200,000		
Hillsborough	1,400,000	30	5	Seminole	200,000		
Holmes: 1 district	40,000	30	6	Walton	70,000	20	6
Jackson	300,000	30	4				
Lake	500,000	[2] 15–30	5	Total	7,285,000		
Manatee	250,000	30	5				

GEORGIA.

Ben Hill	$75,000		5	Miller	$48,000		
Bleckley	8,000			Spalding	10,000		
Clarke	100,000		4	Towns	4,000		
Colquitt	400,000			Troup	200,000		
Gordon	8,000			Turner	20,000		5
Hancock	51,000	30	5				
Laurens	202,000		5	Total	1,176,000		
Marion	50,000						

[1] Bridge bonds only.
[2] Serial.
[3] Bridge bonds, $225,000.
[4] Of this amount $275,000 was for bridges.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

IDAHO.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Ada	$234,484	10–20	4½–5	Kootenai	$83,071	.....	.....
Bear Lake	45,000	4	5½	Lincoln	130,000	10–20	6
Boise	70,000	20	.....	Oneida: Districts 1–3	59,000	.....	5
Canyon	[1] 198,782	10–20	4–5	Twin Falls	[3] 100,000	10–20	5½
Custer [2]	15,000	.....	6	Washington [2]	6,500	.....	6
Fremont: District 1	120,000	10–20	6				
Gooding	160,000	.....	.....	Total	1,221,837	.....	.....

ILLINOIS.

Edwards: District 3	$3,000	2	6	Wabash	$12,000	[5] 5	5
Jackson [4]	36,320	1–20	4½				
Peoria [4]	320,000	.....	.....	Total	420,320	.....	.....
St. Clair: Centerville District	49,000	[5] 20	5				

INDIANA.

Adams	$151,550	10	4½	Marshall	$86,400	15	4½
Allen	53,840	10	4½	Martin	189,881	.....	4½
Bartholomew	365,572	10	4½–5	Miami	636,656	10–20	4½
Boone	223,260	10	4½	Monroe	315,000	.....	.....
Carroll [6]	80,000	.....	4–6	Montgomery	1,795,723	.....	.....
Cass	569,258	.....	.....	Morgan	341,200	10	4½
Districts 1–3	112,425	10	4½	Newton	67,021	.....	.....
Clark	51,250	.....	.....	Ohio	74,000	10	5
Clay	73,800	10	4½	Owen	199,693	20	4½
Crawford	46,000	.....	4½	Parke	390,996	.....	.....
Daviess	90,000	10	4½	Porter: Districts 1–3	1,055,880	10–20	4½–5
Dearborn	232,272	1–20	4½	Posey: Districts 1–3	648,244	.....	4½–6
Decatur	[7] 63,880	10–15	4½	Putnam	54,300	.....	.....
Delaware	100,000	10–20	4½	Districts 1–3	58,689	10	4½
Dubois	196,949	.....	.....	Randolph	27,150	.....	5
Fayette	53,610	10	4½	Ripley	800,000	.....	4½
Fountain	137,950	10	4½	Rush	489,000	10–20	4½–5
Franklin	111,000	.....	3½–5	St. Joseph [6]	523,200	10	4½
Fulton [6]	50,000	20	4½	Shelby [6]	144,425	20	4½–6
Gibson	77,300	10	4½	Spencer	105,000	.....	3½
Greene	42,499	10	4½	Starke	41,000	10	4½
Hancock	[8] 273,500	1–10	4½–5	Sullivan	80,982	10	4½
Harrison	43,220	20	4½	Switzerland	55,652	.....	.....
Henry	41,269	.....	.....	Tippecanoe [6]	260,000	10	4½
Huntington	341,932	10	4½	Tipton: Districts 1–3	673,140	10	4½
Jackson	[9] 29,640	10	4½	Union	60,000	.....	.....
Jasper	127,500	.....	.....	Vanderburg	256,196	10	4½
Jay	50,370	10	4½	Vermilion	462,800	.....	4–4½
Jefferson	113,525	20	4½	Vigo	305,000	.....	4½
Jennings	69,300	10	4½–5	Wabash	145,320	10	4½
Knox	189,360	10	4½	Wayne	88,200	10	4½
Kosciusko	1,440	.....	.....	Wells	[11] 477,791	.....	.....
Laporte	949,640	20	4½	White	513,000	10	4½
Lawrence	93,000	.....	.....	Whitley	8,369	.....	.....
Madison	45,000	10	4½				
Marion	[10] 1,378,000	10–20	3½–4½–5	Total	18,072,049	.....	.....

[1] Bridge bonds $151,162.
[2] Bridge bonds.
[3] $50,000 for bridges.
[4] Bridge.
[5] Serial.
[6] Bridge bonds only.
[7] Bridge bonds $30,000.
[8] Bridge bonds $25,000.
[9] Bridge bonds $15,000.
[10] Bridge bonds $200,000.
[11] Outstanding.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

IOWA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Adams	[2] $102,298			Iowa [1]	$50,000		
Allamakee [1]	24,000			Jackson [1]	137,000	20	4–5
Audubon [1]	42,000			Kossuth [1]	[7] 137,738	6–14	4½
Blackhawk	[3] 14,226			Lee [1]	50,000		
Boone	60,450	12	4½	Lucas	31,600		4½
Buchanan	[3] 15,087			Madison [1]	45,000	3–17	4½–5
Buena Vista	[3] 16,797			Mahaska	117,000		4½
Calhoun [1]	40,000			Marion [1]	107,000	10–20	4–4½
Carroll	40,000		4	Mills	27,000		
Cass [1]	[4] 162,066		4–4½	Palo Alto	4,000		
Cedar [1]	23,000			Plymouth	20,000		5
Cherokee	25,000			Polk	1,219,900		3½–5
Clarke	19,000			Pottawattamie	[3] 37,290		
Clinton [1]	57,000		4½	Sac [1]	25,000		
Crawford	50,000			Shelby [1]	23,092		
Dallas	67,000			Union	96,000		4–4½–5
Davis [1]	47,500		4½	Van Buren	109,000		4½
Decatur	19,000		4½	Wapello [1]	91,000		
Delaware	[3] 3,126			Warren [1]	163,000	20	4
Des Moines	70,000			Winneshiek	[8] 160,000		
Dickinson [1]	10,000			Woodbury [1]	[9] 63,748		
Dubuque	[3] 37,599			Wright	[10] 149,452	9–15	4½–5
Fayette [1]	[5] 55,352		4½				
Floyd	[3] 4,187			Total	[11] 4,006,314		
Fremont [1]	[6] 137,806	20	4½–5				

KANSAS.

Bourbon	$2,700			Marion	$6,000	5–9–11	6
Cloud	13,675			Pawnee [1]	8,000		4½–5
Douglas	66,500		4½	Reno	12,800		6
Edwards [1]	20,000			Sedgwick	101,550	10	5
Geary	86,150		4	Wyandotte	[12] 695,000	20–30	4½
Gray	5,000		6				
Hamilton [1]	31,000	25	4	Total	1,132,375		
Johnson	84,000		5				

KENTUCKY.

Bath	$38,000			Madison	$70,000		
Boyle	4,000		4	Mason	60,000		
Bullitt	50,000		5	Montgomery	29,000		
Carroll	40,672		4–5–6	Nicholas: Districts			
Christian	202,000			1–4	40,000	25	4
Clark	60,000			Ohio	30,000		4
Franklin	23,000			Owen	170,000		5
Gallatin	38,500		4–6	Pendleton	175,000		4½–5–6
Garrard	33,000		4	Robertson	10,400	5–8	5
Grant	90,000		4½–6	Scott	196,000		4–5
Harrison	37,500			Trimble	120,000		
Kenton	197,100			Woodford	17,500		
Lewis	6,200						
Lincoln	22,000			Total	1,759,872		

[1] Bridge bonds only.
[2] Includes $16,298 outstanding warrants.
[3] Outstanding bridge warrants.
[4] Includes $4,060 outstanding bridge warrants.
[5] Includes $5,352 outstanding bridge warrants.
[6] Includes $8,806 outstanding bridge warrants.
[7] Includes $60,738 outstanding bridge warrants.
[8] Includes $65,000 outstanding bridge warrants.
[9] Includes $20,748 outstanding bridge warrants.
[10] Includes $54,452 outstanding bridge warrants.
[11] County officials may issue bonds to pay accumulated outstanding warrants and the above list for the most part represents such funded warrants, all for bridges. It is customary to pay, in most instances, interest at 4, 4½, and 5 per cent.
[12] Bridge bonds $100,000.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

LOUISIANA.

Parishes[1] and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Parishes and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Assumption	$86,000	10	5	Jefferson	$200,000	.....	.....
Bossier	175,000	1–40	5	Lafayette	75,000	25	5
Calcasieu	900,000	25	5	Plaquemines	60,000	.....	.....
De Soto	60,000	10	5	Tangipahoa: District 2	75,000	30	5
East Baton Rouge District 1	15,000	20	5	Tensas	47,000	.....	.....
Franklin	16,914	.....	5	Washington	116,597	2–4	5
Iberia	70,000	10	5	Total	1,932,840	.....	.....
Iberville: Districts 1, 5, and 6	14,329	1–10	5				

MARYLAND.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Allegany	$10,000	2½	5	Kent[2]	$10,000	.....	5
Anne Arundel	37,000	.....	5	Montgomery	144,500	25	4½
Calvert[2]	3,000	.....	5	Prince Georges	16,000	30	5
Caroline	50,000	20	5	Queen Annes	63,000	.....	.....
Cecil	100,000	.....	5	Talbot[2]	37,000	.....	.....
Charles	10,000	.....	5	Worcester	100,000	25	5
Dorchester	43,000	.....	4				
Frederick	127,000	15–30	4½	Total	750,500	.....	.....

MASSACHUSETTS.

Barnstable[2]	$14,000	.....	.....	Norfolk[2]	$50,000	(3)	4.92
Berkshire	5,000	1–2	4½	Plymouth[2]	20,000	.....	4
Bristol	7,000	1–3	4½	Total	813,000	.....	.....
Essex	661,000	.....	3½–4				
Nantucket	56,000	5	4				

MICHIGAN.

Alger	$150,000	.....	.....	Mackinac	$100,000	10–26	5
Alpena	100,000	20	5	Manistee[2]	32,000	.....	.....
Baraga	40,000	.....	6	Mason	100,000	.....	.....
Bay	255,000	.....	.....	Menominee	50,000	.....	.....
Berrien	500,000	15	4	Midland	56,000	15	5
Delta	162,500	.....	.....	Muskegon[2]	25,000	15	4½
Emmet	225,000	.....	.....	Ontonagon	38,000	10	5
Genesee	700,000	10–20	4½	Ottawa	600,000	.....	.....
Gogebic	150,000	10	4½	Schoolcraft	40,000	.....	5
Houghton	30,000	.....	6	Wayne	2,000,000	15	4
Ingham	63,652	.....	.....	Wexford	50,000	.....	.....
Ionia	20,000	.....	.....				
Iron	160,000	.....	5	Total	6,382,152	.....	.....
Kent	735,000	20	4½				

MINNESOTA.

Aitkin[2]	$16,000	.....	6	Lake	$20,000	4	6
Anoka[2]	40,000	.....	4	Mahnomen	5,000	20	4
Beltrami	631,350	20	4	Ramsey[2]	75,000	30	4½
Cook	60,000	.....	.....	St. Louis	300,000	.....	.....
Crow Wing[2]	50,000	.....	6	Winona	50,000	5–7	5
Hennepin	110,000	30	4½				
Itasca[2]	31,000	20	5	Total	1,388,350	.....	.....

[1] Parishes are equivalent to counties. [2] Bridge bonds only. [3] Nine months.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

MISSISSIPPI.

Counties, beats,[1] and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Adams	$150,000		
Alcorn	95,000		5
Attala	50,000	25	5
Benton	6,000		
Bolivar	392,000		4½–6
Calhoun: Beat 1	125,000	25	6
Chickasaw: Beat 3	220,000	20	5
Claiborne	75,000	20	5
Clay: Beats 1–3	221,000	10–25	5–6
Coahoma	225,000		4½
Copiah	305,000		
Beat 2	75,000	25	6
Covington	50,000	30	5
De Soto: Beats 1, 2, 3, and 5	250,000		6
Forrest	120,000		5
Beats 1 and 3	100,000	40	5
Franklin[2]	35,000		5
George	30,000		
Greene	52,000	1–10	5–6
Grenada	[3] 75,000	20	4½
Hancock	[4] 200,000	5–20	1½–2½–6
Hinds	300,000	25	5
Beats 1 and 5	200,000	25	5
Issaquena	[5] 59,500	40	6
Itawamba	65,000		
Jackson	160,000		5
Jasper	25,000		
Jefferson	40,000		
Jefferson Davis	20,000	20	5
Jones	20,000		
Beat 2	50,000	25	5
Lafayette	180,000	25	5½–6
Lamar	71,000		5
Lauderdale: Beats 1 and 5	350,000	30	5–5½
Lawrence	25,000		
Lee	250,000		
Beats 1 and 2	80,000	25	5½–6
Leflore	$300,000	20	5
Lincoln	200,000	25	5
Lowndes: Beat 2	50,000	10–20	5
Marshall	20,000		5
Monroe	535,000		6
Montgomery	40,000		
Neshoba	100,000		
Noxubee	380,000		
Beats 2, 3, and 5	377,500		
Oktibbeha	20,000		
Panola	50,000		6
Perry	80,000		5
Pike	200,000		
Pontotoc	25,000	20	
Prentiss	50,000		
Beat 1	40,000	25	6
Quitman	174,000		4–4½
Rankin	30,000		5
Brandon	10,000		
Scott	75,000		
Sharkey	50,000		5
Simpson	40,000	20	5
Beats 1 and 2	40,000	20	5½
Smith	40,000		
Tallahatchie	140,000		5–6
Beats 1 and 5	75,000	25	6
Tishomingo	35,000		6
Tunica	50,000		4
Union	50,000		6
Warren	[6] 369,000	20	5
Washington	100,000	25	5
Wilkinson[2]	31,372	10–20	5
Yalobusha	62,000	25	5
Beats 2 and 4	48,000	25	5½–6
Yazoo: Four beats	77,500	25	6
Total	8,710,872		

MISSOURI.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Boone[2]	$120,000	2–25	5
Callaway	100,000		
Cedar	19,000		
Christian	6,000		6
Clinton	4,000		5
Clay: Two districts	135,000		
Cooper	3,000		6
Dade	77,000		4
Franklin	325,000	10–20	6
Greene	238,000		6
Grundy	5,000		6
Howell	30,000		
Jefferson	30,000		
Laclede	72,000		4
Lafayette	$125,000	1–15	5½
Lawrence: Mt. Vernon	50,000		
Mississippi	7,000	19	6
New Madrid:			
King's Highway	93,000		
Malden Risco	20,000		
Newton: Neosho	30,000	15	6
Nodaway	15,000		
Pettis	200,000		5
Stone	10,000	17	6
Taney	7,500		
Total	1,721,500		

[1] Counties are subdivided into beats.
[2] Bridge bonds only.
[3] Twelve miles of levee.
[4] Of this amount $150,000 includes bridges, sewers, and culverts.
[5] Bridge bonds, $20,000.
[6] Of this amount $110,400 was issued for building bridges.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

MONTANA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Blaine	$40,000	20	5	Ravalli	$72,106	.....	.....
Broadwater	102,000	.....	.....	Rosebud	[3] 328,000	.....	4½–6
Carbon	90,000	20	5	Sanders	130,000	.....	5
Cascade	60,000	20	5	20 districts	15,000	5–20	5
29 districts [1]	45,000	20	5	Sweet Grass	35,000	.....	4½
Custer	320,000	20	4½	Teton	100,000	.....	.....
Dawson	100,000	.....	4½	33 districts	[4] 100,000	20	5
Flathead	177,500	.....	5	Valley [1]	65,000	.....	.....
Lewis and Clark	105,000	20	4½	Yellowstone [1]	70,000	.....	.....
Lincoln	125,000	20	5				
Meagher	30,000	.....	.....	Total	2,239,606	.....	.....
Musselshell	[2] 130,000	20	5				

NEBRASKA.

Blaine	$5,000	.....	6	Lincoln	$15,000	.....	.....
Dawson [1]	6,000	.....	.....	Morrill [1]	17,000	.....	4½–5
Douglas	[5] 308,000	.....	4½	Nance [1]	82,500	.....	3–7
Garfield [1]	4,000	.....	5	Scotts Bluff	37,000	.....	5–6
Keith [1]	49,000	.....	4–6				
Keyapaha [1]	30,000	.....	3½–5	Total	553,500	.....	.....

NEVADA.

Churchill	$23,000	2–11	.....	Washoe [1]	$97,000	.....	5–6–8
Douglas	15,000	.....	4¾–5				
Ormsby	40,000	20	5	Total	175,000	.....	.....

NEW JERSEY.

Atlantic	$307,000	.....	4–5	Middlesex	$781,500	.....	3½–4½
Bergen	2,121,000	.....	4–4½	Morris	400,000	.....	4
Burlington	55,000	15	4½	Ocean	35,000	30	5
Camden	348,900	.....	4–4½	Passaic	[6] 941,500	14–17	4–4½–5
Cape May	329,300	30	4½	Salem	45,000	.....	4
Cumberland	43,000	.....	4½	Somerset [1]	75,000	.....	.....
Essex	1,140,505	.....	4	Sussex	154,100	.....	4
Gloucester	200,000	.....	4–4½	Union	615,000	.....	4–4½
Hudson	6,098,977	50	4–4½	Warren [1]	30,000	5–10	4
Hunterdon	232,000	30	4				
Mercer	434,000	30	4–4½	Total	14,386,782	.....	.....

NEW MEXICO.

Bernalillo [7]	$100,000	10–30	4½	San Juan [1]	$18,000	20–30	6
Dona Ana	100,000	32	5				
Eddy [1]	28,500	10–20–30	6	Total	246,500	.....	.....

[1] Bridge bonds only.
[2] Of this amount $29,970 was used for building three bridges; balance for 300 miles of road.
[3] Of this amount $113,000 was for bridges.
[4] Of this amount $30,000 was for bridges.
[5] Including inheritance tax.
[6] Of the $136,000 voted in 1913, $26,000 was used for a bridge.
[7] Roads and bridge bonds only.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

NEW YORK.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Albany	$749,000	.....	.....	Ontario	$176,000	.....	.....
Cayuga	29,777	1–20	4½–5	Orange	689,000	30	3½–4½
Chautauqua	160,000	.....	.....	Orleans	156,000	.....	4¼–5
Chemung	99,670	.....	.....	Otsego	60,000	10–15	4–4½–5½
Clinton	15,000	.....	3½–4½	Putnam	38,000	15	4¾
Columbia	56,000	.....	3½–4½	Rensselaer	465,000	.....	3
Erie	1,297,000	.....	3½–4½	St. Lawrence	125,000	6	4
Franklin	533,000	60	4½	Saratoga	150,000	5–14	5
Fulton	70,000	.....	4	Seneca	62,217	10	4. 7–4¾
Greene	109,500	.....	3½–4	Steuben	60,000	.....	4½
Herkimer	408,000	.....	.....	Suffolk	110,000	13½	4½
Jefferson	130,000	.....	4	Tompkins	73,000	.....	4
Lewis	25,244	.....	5–6	Ulster	269,000	.....	4–4½
Livingston	77,106	4	4½–4¾	Warren	215,000	.....	5
Montgomery	201,000	.....	4½	Westchester	275,660	20–25	4½
Nassau	2,007,749	6–20	{ 4–4½– 4. 7–5	Wyoming	52,000	.....	4½
Niagara	4,000	.....	.....	Total	9,097,923	.....	.....
Oneida	150,000	.....	5				

NORTH CAROLINA.

Alamance	$400,000	.....	5	Iredell	$400,000	.....	5
Anson	100,000	.....	.....	Jones [1]	10,000	.....	.....
Beaufort [1]	[2] 125,000	.....	.....	Lee	100,000	40	5
Bertie	20,000	.....	5	Lincoln	200,000	40	5
Brunswick	40,000	.....	.....	McDowell	9,273	5–10	6
Buncombe	50,000	.....	5–6	Madison	300,000	.....	.....
Cabarrus	[3] 145,000	30	.....	Mecklenburg	300,000	.....	.....
Cherokee: Marble District	187,000	.....	.....	Nash and Edgecombe Rocky Mt. District	30,000	30	6
Cleveland	60,000	40	6	New Hanover	550,000	25	4–4½–5
Cumberland [1]	40,000	.....	5	Orange	250,000	.....	.....
Davie	175,000	.....	.....	Pasquotank	10,000	.....	.....
Edgecombe	16,000	.....	6	Polk	[4] 100,000	30	5½
Districts 1–5, 8–11	200,000	55	5	Rutherford	250,000	40	5
Gaston	300,000	.....	4	Sampson	150,000	10–20	5
Granville	160,000	20	4½–5	Stokes [1]	35,000	30	6
Guilford	300,000	.....	5	Vance	220,000	20–40	5
Haywood	60,000	.....	.....	Yancey	150,000	.....	.....
Henderson	49,000	.....	.....				
Hoke	50,000	.....	5	Total	5,541,273	.....	.....

NORTH DAKOTA.

Rolette [1]	$20,000	.....	5	Stutsman	$36,500	.....	6
Stark	6,500	.....	.....	Total	63,000	.....	.....

[1] Bridge bonds only.
[2] By act of legislature, county commissioners have authority to sell bridge bonds without vote of people.
[3] Also 10 steel bridges.
[4] By act of legislature.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

OHIO.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Adams	$181,300	15	3½–6	Lucas	$1,212,437	(6)	4–4½
Ashland	[1] 258,500	10–18	4–5	Madison	132,250	10	5
Ashtabula	[2] 309,500	.....	4½–5	Mahoning	1,408,108	.....	4–4½
Athens	300,000	.....	5	District 1	150,000	25	5
Auglaize	[3] 78,000	13–26	5	Marion	876,175	.....	4–4½–5
Belmont	94,800	.....	.....	Mercer	2,134,600	.....	4–5–5½
Butler	96,000	.....	.....	Miami	[9] 1,047,000	.....	5–6
Champaign	23,750	.....	.....	Montgomery	477,000	.....	4–4½–5
Clark	257,662	.....	4–5–7	Morgan	40,000	.....	4
Clermont	110,200	.....	4–4½–5	Morrow	251,728	.....	.....
Columbiana	300,000	.....	.....	Muskingum	[10] 920,000	.....	5
Coshocton	[4] 150,000	10	4½–5	Noble	48,000	.....	.....
Crawford	8,000	.....	4–6	Ottawa	82,000	.....	5–6
District 1	250,000	.....	.....	Paulding	847,972	7	5
Cuyahoga	6,274,524	.....	4–4½–5	Perry	45,000	10	5
Darke	223,500	.....	4–4½	Pickaway [7]	324,000	.....	5
Defiance	[5] 191,000	(6)	4–4½–5–6	Pike	69,500	3–10	5
Delaware	540,544	.....	4–4½	Portage	224,600	.....	4–4½
Erie [7]	59,500	.....	4	Preble	11,160	.....	.....
Fayette	[8] 909,000	.....	5	Putnam	464,600	9	5
Franklin	513,260	.....	.....	Richland	205,500	.....	4½–5
Fulton	204,400	5	4½	Ross	131,000	25, 30	5
Gallia	542,000	2–20	4–4½–5	Sandusky	195,998	5	4½–5
Geauga	20,000	.....	4½–5	Scioto	[11] 740,000	5	4–8
Greene [7]	41,000	.....	4	Seneca	244,000	.....	4½
Hamilton	917,650	.....	.....	Shelby [7]	17,000	.....	.....
Hancock	408,000	.....	.....	Stark	[12] 605,000	5–15	5–6
Harrison	10,000	.....	4½	Summit	509,050	.....	4½–5½
Henry	937,250	5	5	Trumbull	[13] 905,000	.....	4½–5–5½
Highland	7,850	5	5	Tuscarawas	130,000	1–3	6
Hocking	50,000	.....	4½	Union	[14] 284,600	.....	.....
Huron	6,500	(6)	4½–5	Van Wert	508,260	12–21	4–4½–5
Jackson	500,000	.....	.....	Warren [7]	284,000	1–30	4–5
Jefferson	50,000	.....	.....	Washington [7]	190,000	1–22	5–5½
Knox	61,000	.....	4–5	Wayne [7]	20,000	.....	.....
Lake	278,000	20	4–4½–5	Williams [7]	20,000	.....	4½–5
Lawrence	555,000	.....	4½–5	Wood	[15] 2,072,000	5	4½–5–6
Licking	701,000	5–15	4–5–5½–6	Wyandot	180,400	.....	4½
Logan	30,000	.....	4–4½	13 Districts	7,200	10	5
Lorain	598,000	18	4–5				
District 1	180,000	13	5	Total	35,241,828	.....	.....

OKLAHOMA.

Carter [7]	$200,000	.....	.....	Nowata	$100,000	25	5
Choctaw	120,000	.....	5	Okfuskee [7]	100,000	20	5
Coal [7]	35,000	.....	.....	Osage	100,000	.....	.....
Creek [7]	200,000	10–25	5	Pottawatomie	109,000	.....	5–5½
Delaware	26,000	.....	5–6	Tulsa	75,000	.....	5
Grady [7]	60,000	20	5	Wagoner	75,000	.....	.....
Johnston [7]	100,000	.....	5				
Muskogee	140,000	.....	5	Total	1,440,000	.....	.....

OREGON.

Clatsop	$400,000	20	5	Multnomah	$1,250,000	1–30	5
Jackson	500,000	10–30	5	Total	2,150,000	.....	.....

[1] Of this amount $114,000 bridge bonds.
[2] Of this amount $75,000 flood bonds were issued without a vote.
[3] Of this amount $70,000 for bridges.
[4] Emergency road and bridge bonds.
[5] Of this amount $65,000 used for bridges.
[6] Serial.
[7] Bridge bonds only.
[8] Of this amount $9,000 used for bridges.
[9] $60,000 issued under emergency act of 1913 for bridges.
[10] Of this amount $775,000 used for bridges.
[11] Of this amount $440,000 were 5 per cent flood emergency bonds.
[12] Bridge $250,000.
[13] Bridge $85,000.
[14] Emergency bonds.
[15] Bridge, $6,000 emergency.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

PENNSYLVANIA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Allegheny	[1] $15,900,000	30	3¼–4–4½	Luzerne	[3] $2,690,000	30	4½
Beaver [2]	555,000	2–12	3½–4	Lycoming	382,900	.....	3–3½–4
Bedford	9,500	.....	.....	Mifflin	55,000	.....	4
Berks	475,000	2–12	3½	Montgomery	725,000	.....	3½–4
Butler	20,000	.....	4	Northampton	300,000	.....	3
Cameron	1,000	.....	.....	Potter	25,000	.....	5
Carbon	50,000	5	4	Susquehanna	15,000	.....	5
Clinton [2]	202,500	.....	3½–4	Venango [2]	282,000	.....	.....
Columbia	86,000	.....	4	Washington	1,789,000	5–20	4½
Forest	10,500	.....	5	Westmoreland	250,000	20	4½
Indiana	35,800	.....	.....	Wyoming [2]	72,000	.....	3½–4
Lackawanna	450,000	15	4–4½	York	103,000	.....	.....
Lebanon	29,850	.....	.....				
Lehigh	325,000	.....	.....	Total	24,839,050	.....	.....

SOUTH CAROLINA.

Dillon	[4] $100,000	.....	5	Oconee	$45,000	.....	.....
Horry	10,000	.....	.....	Richland [2]	75,000	.....	.....
Kershaw [2]	40,000	.....	.....	Sumter	50,000	.....	.....
Laurens	50,000	30	4½				
Marion	40,000	.....	4½	Total	410,000	.....	.....

SOUTH DAKOTA.

Pennington [2]	$44,000	.....	.....	Stanley [5]	$33,300	.....	.....
				Total	77,300	.....	.....

TENNESSEE.

Anderson	$300,000	.....	4½–5	McMinn	$325,000	.....	5
Benton	200,000	.....	.....	Madison	500,000	.....	4
Blount	300,000	.....	5	Marion	170,000	.....	4½–5
Bradley	216,000	25–30	5	Maury	175,000	.....	.....
Campbell [6]	4,000	1	.....	Monroe	300,000	.....	.....
Districts 1–5	200,000	.....	4½–5	Montgomery	120,000	30	5
Carter	72,944	.....	5	Morgan	50,000	.....	.....
Elizabeth	65,000	.....	.....	Perry [6]	19,000	7	5
Claiborne	70,000	.....	.....	Polk	405,000	15–30	5–6
Cocke	300,000	.....	5–6	Putnam	250,000	30	4½
Coffee	4,154	.....	.....	Roane	365,000	20–30	4–5
Cumberland	40,000	.....	5	Robertson	450,000	.....	4
Davidson	250,000	.....	4	Sevier	245,500	15	4½–5
Dickson	250,000	30	5	Shelby	2,792,000	12	5
Grainger	100,000	.....	5	Sullivan	530,000	20–30	4½–5
Greene	800,000	30	5–6	Sumner	200,000	30	4½
Hamblen	325,000	40	5	Union	50,000	.....	4
Hamilton	65,000	.....	.....	Warren	168,000	.....	.....
Hawkins	220,000	65	5	Washington	60,000	.....	.....
Hickman	80,000	1–12½	5½	Wayne [6]	47,700	.....	6
Jackson	250,000	.....	.....	White	90,000	.....	.....
Jefferson	150,000	30	5				
9 districts	395,000	25	4½–5	Total	12,474,298	.....	.....
Knox	255,000	.....	.....				
Loudon	150,000	30	5				
5 districts	100,000	.....	5				

[1] Of this amount $550,000 bridge bonds.
[2] Bridge bonds only.
[3] Bridge $100.000 payable serially, last 10 years of term.
[4] Concrete bridge, $17,500.
[5] Certain townships only.
[6] Bridge bonds.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

TEXAS.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Anderson	$150,000	20	5
Atascosa	20,000	.....	3
Austin: Districts 1-3	175,000	5–40	5
Bastrop: Districts 1 and 2	180,000	20–40	5
Baylor	100,000	40	5
Bee	49,922	20	5
Bell	19,960	.....	5
2 districts	200,000	40	5½
Bexar	1,250,000	.....	.....
Borden	7,900	.....	4–5
Bosque: District 7	40,000	40	5
Bowie	250,000	.....	5
Brazoria	450,000	34	4–5
Brooks	45,000	40	5
Brown: District 1	150,000	.....	5
Burnet	47,000	.....	.....
Caldwell	240,000	.....	.....
Calhoun: Districts 1 and 2	235,000	40	5
Callahan	1,276	.....	4
Cameron: District 1	20,000	.....	.....
Cass: District 7	35,000	40	5
Chambers	168,000	20	5
Childress	25,000	.....	4–6
Coke	25,000	.....	.....
Colorado	60,000	40	4
Collingsworth	14,888	5–40	4–6
Collin	450,000	.....	.....
Comal	153,000	40	4–4½–5
Concho [1]	15,000	.....	4–6
Cooke	1,990	.....	.....
District 1	100,000	40	5
Culberson	50,000	40	5
Dallas	1,390,000	.....	4½
Denton: District 1	75,000	40	5
Dewitt	31,998	.....	.....
Dickens	11,500	20–40	5
Dimmit	30,000	.....	.....
Ellis	800,000	.....	.....
El Paso	617,000	40	4
Falls	100,000	.....	3
Fannin	1,900	.....	4
Fayette	69,500	.....	5
Fisher	19,900	.....	4
Foard	83,000	.....	3½–5
Fort Bend	420,000	.....	4–5
Franklin	500	2–50	4½
Freestone: District 1	50,000	.....	5
Frio	86,953	40	5
Galveston	1,500,000	40	5
Garza	50,000	40	4
Gonzales: District 1	160,000	.....	5
Grayson: Districts 1 and 2	685,000	2–50	4½
Gregg	50,000	.....	.....
Grimes	134,000	.....	4–5
Guadalupe	239,500	30–40	4–4½–5
Hall	65,000	.....	2
Hamilton	22,994	5–20	4–6
Hardeman	43,500	.....	4
Hardin	169,000	.....	5
Harris	1,508,000	.....	.....
Haskell [1]	16,000	.....	.....
Hays: District 1	87,000	.....	5
Hemphill	10,000	.....	6
Hidalgo	100,000	.....	.....
Hill	102,000	40–45	3½–5
Precinct 1	250,000	40	5
Hood	36,499	.....	4–5
Hopkins	5,963	40	6
Houston: Districts 1 and 3	174,000	.....	5
Howard	100,000	.....	5
Irion	20,000	40	5½
Jackson	124,500	.....	4–5½–6
Jefferson	809,500	40	4½–5–6
Jim Wells	$125,000	10	5
Johnson	136,200	.....	.....
Jones [1]	7,000	20	5
Karnes	42,000	.....	.....
Kent [1]	10,000	.....	.....
Kerr	40,000	.....	.....
King	5,000	.....	.....
Kinney	80,000	.....	.....
Knox [1]	18,500	.....	3½–5
Lamar: Justice Precinct 1	300,000	10–40	5
Lampasas [1]	45,500	.....	4–5
Lavaca	25,000	.....	.....
Leon: Districts 1, 2, 4, 5, and 6	134,000	.....	.....
Liberty: Districts 1 and 4	425,000	.....	5
Limestone: District 4	300,000	10–40	5
Live Oak	16,990	.....	4–5
Llano [1]	25,000	.....	.....
McCulloch	118,000	40	4–5
McLennan	150,000	40	3–5
McMullen	4,000	.....	5
Matagorda	560,000	.....	.....
Maverick	42,602	.....	5
Medina	60,000	40	4
Menard	20,000	.....	.....
Midland	50,000	.....	.....
Milam	57,872	.....	.....
Districts 2 and 5	200,000	40	.....
Mills [1]	5,400	.....	.....
Mitchell: District 1	30,000	40	5
Montgomery: District 1	250,000	40	5
Motley	25,000	.....	.....
Navarro: Districts 1 and 3	475,000	40	5
Nolan	100,000	40	5
Nueces	175,591	.....	.....
Orange	200,000	.....	5
Palo Pinto	9,750	.....	.....
Parker	25,000	.....	4
Polk	40,000	4	5
Potter	20,000	.....	.....
Reeves	12,000	.....	5
Refugio: Districts 1 and 2	50,000	.....	4
Robertson	500,000	.....	.....
Runnels	57,094	.....	5
San Jacinto	3,000	.....	5
San Patricio	148,000	.....	4–5
San Saba	38,750	.....	4
Shackleford	12,500	40	4–5
Sherman	7,000	.....	.....
Smith	405,000	40	5
Somervell	16,950	20	5
Stephens	18,000	.....	.....
Sterling	10,000	40	.....
Stonewall	50,000	.....	4
Sutton	12,000	.....	3½
Tarrant	1,834,000	20–25	4–5
Taylor: District 1	150,000	.....	5
Throckmorton	2,000	.....	.....
Tom Green [1]	96,000	10–40	5–6
Travis	482,000	.....	4
Trinity: Districts 1 and 2	160,000	40	5
Upshur	149,000	.....	.....
Valverde	6,000	.....	.....
Victoria: District 2	200,000	.....	5
Waller	25,000	.....	4–5
Waller	15,000	40	5
Walker	150,000	.....	.....
Ward	5,000	.....	.....
Webb	10,000	.....	6
Wharton	320,000	.....	3–4½–5
Wheeler [1]	15,000	.....	4

[1] Bridge bonds only.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

TEXAS—Continued.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Wichita	$15,000	.....	.....	Young	$83,996	.....	4–5
Wilbarger	75,500	.....	4	Zavalla [1]	44,999	40	5
Williamson	300,000	.....	4½–5				
Wood	150,000	.....	5	Total	24,960,837	.....	.....

UTAH.

Boxelder	$175,000	20	4½	San Juan	$14,500	20	.....
Cache	45,000	.....	4	Uinta	8,000	20	5
Carbon [1]	30,000	20	5	Weber	120,000	20	4–5
Emery	39,500	.....	5–6				
Grand [1]	8,500	20	5	Total	440,500	.....	.....

VIRGINIA.

Accomac: Atlantic, and Lee	$100,000	.....	5–5½	Northampton: 1 district	$50,000	30	4¾–5
Alleghany [1]	40,000	.....	.....	Orange	175,000	.....	.....
Amherst	215,000	20–30	4½–5	Page [1]	26,000	.....	6
Augusta: South River	250,000	30	5	Pittsylvania: Dan River	100,000	34	5
Botetourt [1]	10,000	.....	.....	Pulaski:			
Brunswick	84,000	.....	.....	Dublin	100,000	.....	5
Charlotte	100,000	.....	4½	Pulaski	70,000	34	5½
Clarke [1]	90,000	.....	4½	Rappahannock:			
Culpeper:				Wakefield	30,000	.....	5
Catalpa	120,000	34	5	Hampton	36,000	.....	.....
Stevensburg	45,000	.....	5	Piedmont	28,000	.....	.....
Dickenson:				Rockingham: Plains	30,000	10	6
Clintwood	54,000	2–30	.....	Russell	575,000	.....	5
Kenady	32,000	1–30	5	Scott:			
Dinwiddie	105,000	20–30	5–6	Esterville	100,000	20–30	5
Elizabeth City	30,000	.....	5–6	Fulkerson	33,800	.....	.....
Fairfax: Mt. Vernon	90,000	.....	.....	Johnson	33,300	20–30	5
Fauquier: Centre	75,000	.....	.....	Smyth: Marion, Rich Valley, and St. Clair	325,000	.....	5–6
Fluvanna	1,300	.....	.....	Spotsylvania:			
Giles [1]	30,000	.....	.....	Courtland and Chancellor	100,000	30	5
Greenesville	80,000	.....	.....	Berkeley and Livingston	100,000	30	5
King George	10,000	.....	.....	Stafford	100,000	.....	.....
Lee:				Tazewell	625,000	.....	.....
Jonesville and 7 districts	440,000	6–36	5–5½	Warren: 3 districts	90,000	.....	6
Lunenburg:				Washington	200,000	.....	5
Plymouth	40,000	.....	5½–6	Westmoreland	25,000	.....	.....
Rehoboth	24,000	.....	5½–6	Wise	960,000	30	5
Browns Store	40,000	.....	5½–6				
Mecklenburg: 7 districts	350,000	.....	5	Total	6,632,400	.....	.....
Montgomery	30,000	.....	4				
Nelson	35,000	.....	7				
Norfolk	200,000	.....	4½				

WASHINGTON.

Asotin	$35,000	.....	.....	Okanogan	$15,000	.....	.....
Clallam	401,000	.....	4½–6–7	Pacific	100,000	.....	5
Clarke [1]	500,000	.....	.....	Snohomish	80,000	20	5
Cowlitz	69,262	.....	.....	Delta	75,000	.....	.....
Jefferson	133,000	.....	5½				
King	3,000,000	.....	.....	Total	4,408,262	.....	.....

[1] Bridge bonds only.

TABLE 22.—*County and district highway and bridge bonds*—Continued.

WEST VIRGINIA.

Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and districts.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Barbour	$40,000	.....	4	Marshall	$150,000	.....	.....
Cabell	300,000	.....	4½	Monongalia	75,000	.....	6
Hancock:				Pleasants: St. Marys	60,000	.....	.....
Baxter and Grant	225,000	.....	.....	Tyler:			
Butler	125,000	.....	.....	Ellsworth	125,000	10–34	6
Harrison	110,000	.....	.....	Lincoln	200,000	10–34	6
Logan [1]	60,000	20	5	Wetzel: Grant	150,000	34	6
Marion:				Wood: Parkersburg	180,000	30	4½
Fairmont	400,000	30	5				
Mannington	300,000	30	5	Total	2,500,000	.....	.....

WISCONSIN.

Ashland	$50,000	20	4	Sauk [1]	$40,000	20	4½
Columbia	20,000	10	4	Vilas	60,000	20	5
Florence	38,000	.....	5				
Iron	35,000	6	4	Total	254,000	.....	.....
La Crosse	11,000	.....	.....				

[1] Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds.*

CONNECTICUT.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Fairfield:				Middlesex:			
Easton	$25,000	40	3½	Chatham	$70,000	.....	4
New Canaan	14,000	.....	4	East Haddam	44,000	20	3½
Stamford [1]	96,000	30	4	New Haven: Derby	60,500	.....	3¾
Wilton	35,000	20	4	New London: Montville	30,000	.....	4
Hartford:				Windham:			
Plainville	20,000	.....	.....	Brooklyn	28,000	25	4
West Hartford	45,000	.....	4	Plainfield	30,000	.....	4
Windsor	40,000	.....	4				
Litchfield:				Total	576,500	.....	.....
Barkhamsted	16,000	.....	3½				
North Canaan	23,000	.....	3½				

ILLINOIS.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Adams: Melrose	$8,000	.....	.....	Clay: Stanford	$900	.....	5
Bond: Central	6,000	.....	5	Clinton:			
Bureau:				Carlyle	5,000	10	4½
Greenville	2,700	.....	5	Germantown	3,105	.....	4
Ohio	17,500	10	5	Santa Fe	200	8	4
Carroll:				Coles: East–Oakland	15,000	5	5
Fairhaven	2,000	.....	5	Crawford:			
Woodland	[2] 3,954	.....	5	Honey Creek	60,000	20–25	5
Wysox	38,500	1–5	5	Hutsonville	12,000	.....	.....
Champaign: Colfax	4,400	4–6	4½–5	Lamotte	58,479	20–25	5
Christian: Mount Auburn	6,000	.....	4½	Martin	43,100	.....	.....
Clark:				Oblong	95,000	20–25	5
Anderson	3,000	.....	5	Robinson	75,000	.....	.....
Westfield [1]	2,250	6	6	Cumberland: Greenup [1]	2,500	.....	5
York	3,000	.....	5	Dekalb: Malta	8,500	2	5

[1] Bridge bonds only.

[2] Of this amount, $1,200 for bridges.

TABLE 23.—*Township highway and bridge bonds*—Continued.

ILLINOIS—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Douglas:			*Per ct.*
Boudre	$35,000	[1] 13	5
Sargent	35,000	2–7	5
Dupage: Naperville	2,300	.....	.....
Edgar:			
Elbridge	2,500	.....	6
Embarrass	35,000	10	5
Hunter [2]	1,500	.....	5
Paris	35,000	.....	5
Effingham: Mason	10,000	.....	6-10
Ford: Button	2,500	.....	5
Franklin:			
Browning	4,500	.....	6
Northern	350	.....	4
Fulton: Orion [2]	7,000	.....	5
Gallatin:			
Bowlesville	1,000	1–2	4
Equality	4,000	.....	6
Shawnee	7,000	1–5	4
Greene: Woodville	250	.....	4
Grundy:			
Goose Lake	2,500	.....	5
Maine [2]	5,500	.....	5
Wauponsee [2]	3,300	.....	5
Hancock:			
Appanoose	1,835	.....	5
Hancock	6,550	.....	5–5½
Henry:			
Alba [2]	3,560	6	5
Atkinson	5,900	10	5
Geneseo [2]	15,450	3-19	5
Loraine [2]	2,100	.....	5
Phenix	4,250	.....	5
Yorktown	2,500	.....	5
Iroquois:			
Belmont	6,000	.....	5
Chebanse [2]	4,000	.....	5
Milford [2]	10,000	.....	5
Pigeon Grove	5,000	10	6
Sheldon	37,500	.....	5
Jackson:			
Carbondale	35,000	3–5	5
De Soto	7,325	.....	6
Fountain Bluff	1,250	.....	5
Sand Ridge	3,900	.....	4½
Jasper:			
Grove	500	.....	.....
Wade	478	.....	.....
Jefferson:			
Blissville [2]	1,000	.....	.....
Farrington [2]	1,000	.....	.....
Jo Daviess:			
Derinda	1,500	.....	.....
Elizabeth	2,500	.....	.....
Pleasant Valley	10,000	.....	5–6
Kankakee:			
Ganeer	35,000	.....	.....
Momence	35,000	.....	.....
Yellowhead	35,000	.....	.....
Knox: Haw Creek	2,500	.....	5½
La Salle:			
Deer Park	22,000	.....	5¼–6
Farm Ridge	2,000	.....	.....
Mission	3,750	.....	5
Utica	26,500	.....	5¼
Lake:			
Antioch	4,000	.....	5
Newport	9,325	28	4–5½
Lawrence:			
Bond	6,150	.....	6
Denison	35,000	6	5
Lee:			
Ashton	44,000	20	5
China	25,000	.....	.....
East Grove [2]	3,500	20	.....
Lee—Continued.			
Hamilton	$12,800	.....	5–6
Harmon	[3] 9,125	.....	5
Viola	13,000	1–13	5½
McLean: Martin	2,200	.....	6
Macoupin: Bird	8,000	.....	.....
Madison: Godfrey	1,200	.....	5
Montgomery:			
Hillsboro	16,000	[1] 5–8	5
Witt	2,200	.....	6
Moultrie:			
East Nelson	3,500	.....	5
Lovington [2]	7,375	.....	6
Ogle:			
Maryland	4,500	.....	5
Pine Rock	2,000	13	5
Rockvale	9,000	.....	5
Woosung	15,000	.....	5
Peoria:			
Jubilee	2,000	.....	5
Logan [2]	7,000	8	5
Timber [2]	1,500	.....	6
Pike:			
Derry [2]	3,075	.....	5½
Fairmount	300	.....	.....
Hadley	525	.....	.....
Hardin	1,200	.....	.....
Kinderhook	700	.....	.....
Pleasant Hill	1,200	.....	.....
Richland: German	1,798	.....	6
Rock Island: Black Hawk	5,500	.....	6
St. Clair:			
Centerville	2,500	.....	.....
Fayetteville	2,000	.....	.....
Freeburg	7,400	10	.....
New Athens [2]	8,000	12	4–5
O'Fallon	6,000	.....	5
St. Clair [2]	3,200	4	5
Shiloh Valley	9,550	15	4–5
Saline:			
Brushy	1,500	.....	5
Cottage [2]	1,694	3	6
Galatia	1,400	.....	6
Harrisburg [2]	6,215	.....	6
Independence [2]	800	.....	6
Mountain	2,372	.....	6
Raleigh	2,000	.....	6
Stonefort	5,000	.....	6
Sangamon: Salisbury [2]	6,000	5	5
Stephenson:			
Jefferson	3,000	.....	5
Waddams	6,000	.....	.....
Tazewell:			
Hopedale [2]	1,142	4	5
Mackinaw [2]	9,000	.....	5½
Tremont	6,500	.....	5
Vermilion:			
Grant	15,777	.....	.....
Jamaica	6,500	.....	.....
Middlefork	5,000	.....	.....
Washington: Bolo	240	.....	.....
Wayne:			
Big Mound	11,600	.....	6
Leech [2]	4,000	5	6
Massilon	[4] 6,125	5	6
White:			
Burnt Prairie	11,000	.....	6
Emma	25,000	.....	5
Hawthorne	27,500	.....	5
Mill Shoals	5,000	1–10	6
Whiteside:			
Newton	5,820	11	6
Portland	15,000	16	5
Sterling	16,000	.....	.....

[1] Serial.

[2] Bridge bonds only.

[3] Of this amount, $3,000 bridge bonds.

[4] Of this amount, $3,125 for bridges.

TABLE 23.—*Township highway and bridge bonds*—Continued.

ILLINOIS—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Will:			*Per ct.*
Channahon	$5,500		5
Crete	35,000	13	5
Custer	3,000	3	5
Dupage	1,500		5
Winnebago:			
Cherry Valley	12,325		5
New Milford	17,725		5–6–6½
Winnebago—Contd.			
Roscoe	$35,000	5	5
Woodford:			6
Patridge	1,300		
Spring Bay	2,700		5
Total	1,618,634		

INDIANA.

Adams: Townships	$1,026,321	(2)	4½
Allen: Townships	134,132	1–20	4½
Bartholomew: Townships	780,180	10	4½
Blackford: Townships	[1] 249,063	10	4½
Benton: Townships	723,560	10	4½–6
Boone: Townships	127,150	10	4½
Carroll: Townships	1,016,686	[3] 10	4½
Cass: Townships	[1] 692,158		
Clark: Townships	[1] 213,138	[3] 10	4½
Clay: Townships	1,004,354		4½–6
Clinton: Townships	850,000	10	4½
Crawford: Townships	71,806		4½–5
Daviess: Townships	934,988	[3] 1–20	4½
Dearborn: Townships	219,330	1–20	4½
Decatur: Townships	779,583	10	4½
Delaware: Townships	850,000	10	4–5
Dubois: Townships	216,400		4½–6
Fayette: Townships	[1] 39,609		4½
Fountain: Townships	425,000	10	4½–6
Franklin: Townships	173,820	10	3½–6
Gibson: Townships	808,770	10	4½–5½
Grant: Townships	760,702	10	4½
Greene: Townships	861,062		4½
Hamilton: Townships	525,836		
Hancock: Townships	255,065		4½–5
Harrison: Townships	202,887		4½–5
Hendricks: Townships	315,846		4½
Henry: Townships	47,408		4½
Howard: Townships	736,000	10	4½
Huntington: Townships	[1] 301,289	10	4½
Jackson: Townships	[1] 230,000		
Jasper: Townships	[1] 237,195	10	4½
Jay: Townships	310,828	10	4½
Jefferson: Townships	135,119	20	4½–5
Jennings: Townships	417,210		4½–5
Johnson: Townships	127,025	10	4½
Knox: Townships	[1] 824,496	10	4½
Kosciusko: Townships	1,440		
Lake: Townships	[1] 1,766,211		
Laporte: Townships	[1] 654,320	[3] 20	4½
Lawrence: Townships	[1] 384,630	10	4½
Madison: Townships	849,820		
Marion: Townships	[1] 40,735		
Marshall: Bourbon	[1] 28,500	15	4½
Martin: Townships	$148,870	1–12	
Miami: Townships	504,530	10–20	4½–5
Monroe: Townships	599,465		3½
Montgomery: Townships	849,820		4½–6
Morgan: Townships	393,689		4½
Newton: Townships	456,125		4½–6
Ohio: Townships	20,078		
Orange: Townships	[1] 170,541		
Owen: Townships	394,089	40	4½–5
Parke: Townships	893,367	10	4½
Perry: Townships	73,000	20	4½
Pike: Townships	152,296		
Porter: Townships	[1] 725,516		
Posey: Townships	[1] 473,231		
Pulaski: Townships	[1] 270,229		
Putnam: Townships	757,005		4½
Randolph: Township	[1] 517,176		4½
Ripley: Townships	[1] 259,366		
Rush: Townships	625,742		4½–5½
Saint Joseph: Townships	[1] 23,500		
Scott: Townships	108,856	10	4½
Shelby: Townships	166,805	20	4½–6
Spencer: Townships	[1] 37,300		4½–6
Sullivan: Townships	1,215,564		4½–5
Starke: Township	[1] 254,429		
Switzerland: Townships	160,019		4½–5
Tippecanoe: Townships	[1] 273,930		4½–6
Tipton: Townships	[1] 76,372		
Union: Townships	79,711		4½
Vanderburg: Townships	[1] 137,600		4½
Vermilion: Townships	[1] 292,132		
Vigo: Townships	601,222		
Wabash: Townships	784,220	1–20	4½
Warren: Townships	[1] 402,270		
Warrick: Townships	78,163		4½
Washington: Township	[1] 232,799	10	4½
Wayne: Townships	410,940	10	4½
Wells: Townships	[1] 473,660		
White: Townships	[1] 385,680		
Whitley: Townships	[1] 8,369		
Total	35,837,348		

[1] Outstanding Jan. 1, 1913. [2] Six months. [3] Serial.

TABLE 23.—*Township highway and bridge bonds*—Continued.

KANSAS.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.				*Per ct.*
Allen: Iola	$33,000		6	Mitchell: Pittsburg [1]	$26,000		5
Barton:				Neosho: Mission	32,000		
Lakin [1]	20,000		6	Ottawa: Center	9,500		7
Liberty [1]	6,000			Pottawatomie:			
Butler: Douglass	9,000		4–4½	St. Mary's	40,000		4½
Cherokee: Shawnee	150,000			Womego	35,000		6
Cloud:				Riley: Manhattan	12,200		
Lincoln [1]	18,700	10–30	6–10	Rush: Belle Prairie	1,000		6
Shirley	1,565			Sedgwick: Payne	5,000		5
Sibbey	2,000	5	5	Wabaunsee: Kaw	9,000		5
Comanche: Township	54,000			Wilson:			
Douglas: Grant	2,500			Center	7,000		
Finney: Garden City	16,000		6	Clifton	2,100		6
Franklin: Cutler [1]	2,500			Fall River	4,900		
Geary: Junction City	89,600	9–10	5–6	Guilford	10,000		
Hamilton: Coolidge	18,000		5	Neodesha	12,000		
Kingman: Bennett	17,500	30	5½	Wyandotte: Township	5,000		
Kiowa: Glick [1]	5,000	(2)					
McPherson: Township	6,000			Total	677,065		
Marshall: St Bridget	15,000		5				

MAINE.

Kennebec: Benton	$1,500	5	4	Waldo: Frankfort [1]	$1,000		5
Knox: Vinal Haven	2,500			Washington: Jonesport	1,000	6 mos.	6
Oxford: Norway [3]	35,000	35	4				
Penobscot: Orono [1]	12,000	2–3–4	4	Total	78,000		
Piscataquis: Foxcroft [1]	25,000	1–25	4				

MASSACHUSETTS.

Barnstable:				Franklin—Con.			
Barnstable	$40,500		4	Northfield [1]	$30,000		3½
Brewster	15,000			Sunderland	2,500		4
Harwich [1]	63,400		5½	Hampden:			
Mashpee	400		4	Russell	14,000		4
Wellfleet	24,000		3½–4	Westfield	100,000	10	4
Bristol:				Hampshire: Amherst	50,000		4
Fairhaven [1]	42,000	42	4	Middlesex: Billerica	18,000		4–4½
North Attleboro	6,000	1–6	5	Nantucket: Nantucket	36,000	10	5
Somerset [1]	8,000		4	Norfolk: Millis [1]	5,856	3	4
Swansea	4,000		4	Plymouth:			
Essex:				East Bridgewater	5,000		4
Amesbury	16,000		4	Plymouth	100,517		4–4½
Marblehead	45,000		4	Worcester: Grafton	3,800		4
Franklin:							
Conway	15,000	10		Total	650,473		
Gill	4,500		4–4½				
Monroe [1]	1,000		4				

MICHIGAN.

Alcona: Mikado	$2,000		5	Benzie: Crystal Lake	$20,000		
Allegan:				Berrien: 3 townships	89,000		
Gunplain	20,000		4½	Branch: Union	10,000	5	5
Saugatuck	18,000		4½	Charlevoix: Hudson [1]	1,100		7
Antrim:				Cheboygan:			
Banks	20,000	20	5	Benton	10,000		5
Central Lake	20,000			Forest	7,000		6
Arenac: Au Gres	1,550			Walker	5,000		5
Baraga:				Chippewa:			
Arvon	10,000			Sugar Isle	2,000		6
Covington	18,000			Trout Lake	10,000		
L'Anse	25,000		6	Clare: Redding	3,000		5

[1] Bridge bonds only. [2] Serial—1989. [3] For roads and sewers.

TABLE 23.—*Township highway and bridge bonds*—Continued.

MICHIGAN—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Crawford: 2 townships	$16,000		*Per ct.*
Delta:			
Bark River	12,300	10	5
Escanaba	5,000	5	5
Ford River	3,000		5
Wells	10,000		5
Dickinson: Norway	8,000		5
Genesee:			
Davison	8,300		5½
Forest	10,000		4
Montrose	7,000	6	5
Thetford	10,000	10	5
Vienna	10,000		5
Gladwin: Bourret	3,500		5
Gogebic: Marenisco	20,000	20	7
Grand Traverse:			
Paradise	30,000		
Whitewater	24,000		
Green Lake	18,000		
Hillsdale: Fayette	3,450	1	5
Houghton: Chassell	3,000		6
Huron:			
Bingham	2,000		
Bloomfiel	2,000		6
Brookfield	15,000		5
Colfax	20,000		
Oliver	12,000		5
Sebewaing	75,000		
Windsor	50,000	10	4½
Ionia:			
Ionia	12,000		5
Lyons[1]	12,000		5
Isabella: Vernon	6,000		
Iron:			
Crystal Falls	15,000		5
Mastadon	20,000		
Kalkaska:			
Clearwater	6,000		
Cold Springs	5,000		
Springfield	9,000		
Lake:			
Ellworth	6,000		5
Newkirk	6,000		5
Leelanau:			
Empire	11,000		5
Leelanau	20,000		
Townships (3)	26,000		
Mackinac:			
Garfield	8,903		5
Hudson	4,000		
Newton	5,000		
Macomb:			
Lake	50,000		
Warren	36,000		
Manistee:			
Maple Grove[1]	1,100		7
Springdale	10,000		
Stronach	500		5
Marquette:			
Powell	30,000		
Wells	5,000		5
Mecosta: Wheatland	1,000		
Mason:			
Custer	20,000		
Free Soils	15,000		
Riverton	20,000		
Menominee: Stephenson	11,000	10	5–7
Midland:			
Edenville[1]	9,000		5
Greendale[1]	3,000		4½
Ingersoll	10,000	11	5
Jerome	6,500		
Midland—Continued.			
Larkin	$1,413		
Mount Haley	1,000		5
Missaukee:			
Butterfield	4,000		6
Clam Union[1]	800		4
Pioneer	6,000	3–9	5
West Branch	3,000		
Monroe:			
Bedford	39,000	13	5
Erie	40,000		
Ida	30,000	20	5
Whiteford	60,000		5
Montcalm:			
Eureka	725	10	5
Montcalm	1,045		5
Reynolds	10,000		5
Newaygo:			
Ensley	1,200		5
Grant	7,500		5
Groton	20,000		
Four townships	39,000		
Oceana:			
Elbridge	20,000	21	5
Golden	19,500		5
Greenwood[1]	1,267	3	6
Hart	44,250		
Pentwater	20,000		6
Shelby	14,000		5
Weare	3,000		5
Ogemaw: Cumming	5,000	20	5
Ontonagon:			
Ontonagon	10,000		5
Carr Lake	20,000		
McMillan	9,500		
Rockland	28,500		
Osceola:			
Burdell	10,000		5
Evart	14,000	20	5
Hartwick	8,000		5
Hersey[1]	6,000		5
Lincoln	5,000		5
Marion	12,000		5
Osceola	25,000	15	5
Otsego: Hayes	600		7
Ottawa: Robinson	8,000	16	5
Presque Isle: Allis	2,800		5
Roscommon:			
Gerrish	15,000		5
Richfield	18,500	25	5
Saginaw:			
Blumfield	10,000		4
Bridgeport	20,000		
Maple Grove	10,000		4½
Richland	20,000		4½
St. Charles	10,000		5
Spalding	5,000		4½
St. Clair:			
East China[1]	3,000		5
Kimball	25,000		4
Sanilac:			
Forrester	5,000	10	5
Wheatland	5,000	5	5
Schoolcraft:			
Hiawatha[1]	4,000		6
Mueller	6,000	9	5
Tuscola:			
Ellington	3,832		6
Fairgrove	20,000		
Wellington	4,500		
Van Buren:			
Covert	25,000	5	5
South Haven	25,000	5	5
Washtenaw: Salem	5,000		

[1] Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds*—Continued.

MICHIGAN—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Wayne: Redford	$50,000	20–30	4½
Wexford:			
Antioch	2,000	.....	5
Cherry Grove	5,000	.....	.....
Greenwood	5,000	.....	5
Wexford—Contd.			
Henderson	$2,000	.....	.....
South Branch	2,000	.....	5
Total	1,926,135	.....	.....

MINNESOTA.

Aitkin:			
Cornish	$6,000	.....	4
Fleming	1,200	.....	4
Haugen	7,000	.....	4–6
Hebron	3,500	.....	6
Jevne	4,000	20	4
Jewett	3,500	.....	6
Pequadna	3,000	.....	6
Pliny	4,000	19	4
Verdon	1,000	.....	6
Wagoner	5,000	.....	4
Wealthwood	7,300	.....	6
Williams	7,000	.....	4
Workman	5,000	.....	6
Becker: Spring Creek	1,500	.....	4
Beltrami:			
Eland	2,000	6	4
Kelliher	7,000	.....	6
Wabanica	3,500	.....	4
Benton:			
Alberta	1,100	.....	.....
Longola	3,000	[1] 18	4
Watab	1,500	.....	6
Bigstone: Otrey	2,150	5	6
Brown: Prairieville [2]	2,000	.....	6
Carlton:			
Barnum	2,200	15	5
Beseman	8,000	.....	6
Blackhoof	3,000	15	4
Carona	1,500	.....	.....
Eagle	3,000	.....	4
Holyoke	10,000	15	6
Kalavala	3,000	15	4
Knife Falls	3,000	10–15	7
Lakeview	9,603	20	6
Mahtowa	3,000	20	4
Red Clover	3,500	13	4
Split Rock	3,000	13	4
Chippewa:			
Crate	5,000	5–20	4
Lone Tree [2]	3,000	20	3
Chisago:			
Rushseba [2]	600	7	6
Sunrise [2]	5,000	6	4
Clay:			
Felton	6,500	.....	4
Flowing	1,000	.....	6
Morken	4,500	19	10–7
Cook:			
Colvill	12,000	.....	6
Grand Marais	15,000	.....	6
Hovland	20,000	(1)	6
Maple Hill	15,000	.....	6
Schroeder	8,000	14	7
Cottonwood: Rose Hill [2]	2,000	.....	4
Crow Wing: Littlepine	3,000	5	4
Dakota:			
Randolph [2]	2,360	.....	5–6
Waterford [2]	2,500	4	5
Dodge: Ashland	2,650	1	6
Douglas: Belle River	2,300	.....	5–7
Fillmore: Pilot Mound	7,500	.....	6
Goodhue:			
Central Point [2]	$500	.....	5
Vasa [2]	4,800	.....	5
Houston: Yucatan [2]	2,500	5	5
Hubbard:			
Alice	3,000	[1] 10	4
Badoura	200	.....	4
Farden	1,200	10	4
Guthrie	1,000	6–10	4
Hart Lake	1,000	.....	4
White Oak	3,000	5–20	4
Isanti: Stanford [2]	500	.....	.....
Itasca:			
Alvwood	2,000	5	4
Ardenhurst	3,500	.....	4
Balsam	20,000	.....	6
Bass Brook	15,000	4–15	5½
Bigfork	8,000	20	6
Deer River	12,000	.....	6
Feeley	3,000	20	6
Grand Rapids	10,650	.....	5
Marcell	10,000	20	6
Trout Lake	8,500	3–21	6
Jackson:			
Enterprise [2]	3,000	.....	4
Sioux Valley	3,600	.....	4
Kanabec:			
Kroschel	3,400	.....	4
Pomrey	4,100	11	4
South Fork	1,500	.....	4
Hillman	3,000	10	4
Kandiyohi: Lake Elizabeth	550	.....	.....
Kittson:			
Davis	1,000	10	6
Hallock	12,300	.....	4–7–10
Percy	3,500	.....	4½
Red River	1,100	10	7
St. Vincent	3,000	.....	4
Spring Brook	1,400	5–11	4
Svea	1,000	.....	4
Teien [2]	6,000	.....	4
Thompson [2]	7,800	.....	4
Koochiching:			
Bannock	3,000	10	4
Cingmare	12,000	.....	6
Dinner Creek	3,000	.....	4
Englewood	2,000	[1] 1–20	4
Forest Grove	2,000	6–16	4
Grand Falls [2]	1,500	10	6
Jameson	10,000	20	6
Koochiching	15,000	.....	6
Lindford [2]	3,000	12	4
Meding	7,000	10	4
Pine Top	5,000	10	6
Reedy	6,000	10	4
Sturgeon River	3,000	.....	6
Wildwood	8,000	4–11	6
Lac Qui Parle:			
Mehurin	2,400	.....	4
Ten Mile Lake	50,400	.....	4
Lake:			
Two Harbors	2,500	.....	.....
Waldo	3,500		4

[1] Serial.

[2] Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds*—Continued.

MINNESOTA—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Lincoln: Diamond Lake	$500	.....	*Per ct.* .....
Lyon: Eidsvold [1]	1,025	.....	8
McLeod:			
Collins	3,000	.....	4
Rich Valley	1,000	.....	6
Mahnomen:			
Beaulieu	1,000	.....	4
Bejou	1,500	20	.....
Heier	1,000	.....	4
Townships	6,600	.....	.....
Marshall:			
Alma	1,200	5–9	4
Big Woods	1,400	5	8
Donnelly	1,000	10	7
Lincoln	6,000	20	6
Vega	1,300	.....	4
West Valley	1,000	20	4
Millelacs:			
Bogus Brook [1]	2,200	.....	4
East Side	1,500	.....	4
Kathio	12,000	20	4
Onamia	4,000	.....	4
Page	7,000	9	4
South Harbor	3,000	(2)	4
Morrison:			
Hillman	4,000	14	4
Rosing [1]	800	6–13	6
Murray: Des Moines River	1,200	.....	4
Nicollet: Belgrade	4,000	.....	6
Nobles: Townships	5,700	10	4
Norman:			
Anthony [1]	500	.....	4
Good Hope	3,000	.....	6
Hegne	800	5–10	10
Olmsted: Rochester	1,769	.....	4½
Ottertail:			
Buse [1]	1,058	.....	6
Eagle Lake	400	.....	.....
Maine	2,000	.....	4
Paddock	1,000	.....	.....
Pennington:			
High Landing	3,000	.....	6
Rocksbury	1,500	10	10
Pine:			
Arna	2,000	.....	5
Brookpark	5,540	.....	4
Bruno	14,000	.....	5½–6
Chengwatana [1]	3,000	.....	4
Danforth	4,000	.....	4
Fleming	10,000	13	6
Kettle River	3,600	.....	.....
Mission Creek	5,000	.....	6
Partridge	9,500	.....	6
Pine City [1]	2,400	6–13	4
Pokegama	1,700	10	4
Rockcreek	1,600	.....	4
Wilma	2,500	.....	4
Pipestone: Sweet	2,500	.....	4
Polk:			
Fairfax	3,500	5–15	4
Farley	12,000	5	4
Gentilly	1,000	.....	4
Nesbit	5,000	20	6
Sandsville	1,000	10	10
Sullivan	14,000	.....	4–10
Tabor	1,300	.....	6
Pope: New Prairie [1]	$800	.....	6
Ramsey: White Bear	12,500	.....	4
Red Lake:			
Lake Pleasant	1,000	.....	.....
Terrebonne	1,700	.....	5
Redwood:			
Brookville	3,000	5–10	4
Sundown	4,000	.....	7
Renville: Crooks	2,500	.....	5
Rice:			
Bridgewater [1]	3,000	.....	5
Flora	2,000	5	4
Rock:			
Denver	1,600	.....	6
Kanaranzi	3,500	.....	6
Luverne	2,500	.....	6
Springwater [1]	8,000	.....	6–8
Roseau:			
Cedarbend	1,700	.....	4
Deer	4,000	20	6
Dieter	9,500	.....	6
Grimsted	6,000	.....	.....
Jadis	6,000	.....	6
Lind	1,600	.....	4
Malung	1,000	.....	6
Mickinock	6,600	.....	6
Moose	8,600	.....	6–7
Pohlitz	5,000	.....	6
Ross	10,000	10	6
Spruce	5,000	.....	6
Stafford	5,900	5	4–6
Stokes	9,500	20	6
St. Louis:			
Ault	6,000	.....	6
Beatty	3,000	.....	4
Canosia	10,000	.....	10
Clinton	3,000	10–15	6
Mesaba	15,000	.....	5½
Scott: Belleplaine	1,500	3	5
Sherburne:			
Elk River	5,000	.....	6
Livonia	1,000	.....	4
Talmer	2,400	.....	5
Sibley: Dryden	1,000	.....	.....
Stearns:			
Brackway	1,500	.....	4
Grove	1,800	.....	6
Paynesville	3,000	.....	4½
Steele: Lemond	1,400	.....	6
Stevens: Baker	850	.....	.....
Todd: Little Elk	5,000	7–16	4
Wadena:			
Bullard	1,500	(2)	4
Huntersville	2,500	.....	.....
Orton	3,000	.....	4
Wing River [1]	1,900	9	4
Washington: Newport	20,000	.....	5
Watonwan; Adrian	3,000	2 5	5
Wilkin: Andrea	2,000	.....	5
Wright: Townships	3,000	.....	4
Yellow Medicine:			
Oshkosh [1]	4,000	.....	4
Wright	3,000	.....	.....
Total	982,805	.....	.....

[1] Bridge bonds only.

[2] Serial.

TABLE 23.—*Township highway and bridge bonds*—Continued.

MISSOURI.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Nodaway:			*Per cent.*
Polk	$50,000	.....	.....
Union	15,000	(1)	6
Total	65,000	.....	.....

NEBRASKA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.	Platte—Continued.			*Per ct.*
Dawson: Lexington	$6,000	.....	.....	Loup	$3,000	15	6
Keith: Ogallala	26,670	.....	.....	Oconee [2]	6,000	15	6
Lincoln:				Scotts Bluff:			
Bostwick	4,000	.....	.....	Castle Rock and Highland	12,000	.....	.....
Hershey	20,000	.....	.....	Gering	10,000	20	5
Merrick: Loup	3,000	.....	.....	Winter Creek	15,000	.....	.....
Morrill: Township	14,000	.....	.....				
Nance:				Total	246,170	.....	.....
Genoa	82,500	20	6				
Township	14,000	.....	.....				
Platte:							
Columbus	30,000	.....	.....				

NEW HAMPSHIRE.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per cent.
Grafton: Bristol	$15,000	.....	3
Merrimack: Hookset [3]	25,000	20	4
Total	40,000	.....	.....

NEW JERSEY.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Atlantic:			*Per ct.*	Camden:			*Per ct.*
Egg Habor	$95,000	8–13	4½	Delaware	$7,000	.....	5
Hamilton	97,000	.....	.....	Gloucester	6,000	.....	5
Bergen:				Haddon	2,900	.....	5
Franklin	75,000	.....	4	Voorhees	2,500	.....	5
Hillsdale	45,000	5	5	Cape May: Lower	5,000	.....	5
Hohokus	22,000	.....	4½–5	Essex: Belleville	87,000	.....	4
Midland	30,000	.....	5	Gloucester:			
Orvil	7,000	.....	5	Monroe	500	.....	5
Overpeck	75,500	.....	5	Wollwich	3,900	.....	5
Riverdale	25,000	31	5	Hunterdon: West Amwell	4,900	.....	4½
Union	42,500	30	4	Monmouth: Neptune	23,000	.....	4½–5
Washington	14,500	.....	5	Salem: Upper Pittsgrove	800	.....	5
Burlington:				Union: Cranford	8,600	.....	5
Chester	40,000	.....	4½				
Northampton	15,000	30	4	Total	760,600	.....	.....
Pemberton	10,000	.....	4½				
Southampton	15,000	30	4½				

[1] Serial bonds. [2] Bridge. [3] Bridge bonds.

TABLE 23.—*Township highway and bridge bonds*—Continued.

NEW YORK.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Allegany:			
Angelica	$9,000		
Scio	5,000		
Chautauqua:			
French Creek	3,000	3	4½
Kiontone	4,000	4	
Westfield	28,000		4
Chemung:			
Big Flats	40,645		4½
Chemung	20,000		4½
Elmira	3,408		4½
Cortland:			
Cortlandville	14,000		
Homer	4,000		
Marathon	4,800		
Delaware:			
Middletown	6,000		
Sidney	1,400		
Essex:			
Chesterfield	1,500		
Keene	5,500		
Lewis[1]	6,500		
St. Armand	4,000		
Franklin:			
Bombay	3,000		
Malone	8,000		
Moira	7,000		
Fulton: Caroga	35,000	6	5
Genesee: Le Roy[1]	12,000		
Hamilton: Long Lake	30,000		
Herkimer:			
Frankfort	2,765	4	5½
German Flats	6,000		
Herkimer	88,232	11	4½
Manheim	25,771	12	4½
Newport[1]	12,500	16	4
Russia	3,000		
Salisbury	5,900	5	5
Schuyler	12,530		
Webb	17,000	19	5
Jefferson:			
Clayton	18,000		
Ellisburg[1]	24,000		
Henderson	9,000		
Lyme[1]	25,000		
Jefferson—Contd.			
Philadelphia	$8,000		
Rutland[1]	6,000		
Lewis:			
Denmark	6,000	6	5
Lowville[1]	9,000		
Oneida:			
Augusta	10,000		
Kirkland	11,500		
Paris	5,000		
Vernon	20,000		
Otsego:			
Maryland	3,000		
Unadilla	5,500		
Westford	2,500		
Putnam: Putnam Valley	25,000	12	4¼
Schenectady: Princetown[1]	1,200	1–4	6
Seneca: Lodi	1,200		
Steuben:			
Canisteo	1,000		
Corning	13,000	2–5	5
Rathbone	2,480		
Suffolk:			
East Hampton	70,000	6–20	4
Huntington	17,703		
Babylon and Southampton	80,000		
Tompkins:			
Lansing[1]	5,000	(2)	4½
Trumansburg	25,000		
Westchester:			
Bedford	5,517	6–19	4–5
Cortland	196,393		
Eastchester	259,000		4–5
Greensburg	357,500		4
Harrison	310,600		4–4½
New Castle	145,693		
North Castle	4,578		
Pelham	18,000		
Rye	135,000		
Scarsdale	147,350		
White Plains	218,000		
Total	2,631,165		

NORTH CAROLINA.[3]

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Alleghany: Township	$50,000		
Anson: Wadesboro	2,000		
Ashe: Horse Creek	5,800		
Bertie: Township	5,000		
Bladen: Township	10,000		
Brunswick:			
Smithville	35,000		5
Towncreek	15,000	20	5
Buncombe: Black Mountain	20,000		
Burke: Morganton	50,000		
Caldwell: Lovelady	25,000		
Carteret:			
Morehead	10,000	42	5
Newport	3,000	42	5
Catawba:			
Hickory	$50,000		
Newton	50,000		
Cherokee:			
Murphy	50,000	20	6
Valley Town	47,000		5½–6
Cleveland:			
Kings Mountain	25,000	30	5
Shelby	50,000	15	5
Townships 6 and 7	50,000		
Davidson: Lexington	100,000		
Duplin:			
Calypso	5,000		
Faison	15,000		
Rosehill	20,000		

[1] Bridge bonds only.
[2] Serial.
[3] By act of legislature, county commissioners have authority to sell bridge bonds without vote of people.

TABLE 23.—*Township highway and bridge bonds*—Continued.

NORTH CAROLINA—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Duplin—Continued.			*Per ct.*
Wallace	$5,000		
Warsaw	20,000		
Franklin:			
Franklinton	140,000	30	5–5½
Louisburg	70,000		5½
Youngsville	55,000		6
Greene: 7 townships	180,000		
Halifax:			
Enfield	60,000		
Halifax	40,000		
Haywood: Waynesville	50,000		5
Henderson:			
Edneyville	12,000		
Hendersonville	50,000		
Hoopers Creek	20,000		
Jackson:			
Cullowhee	30,000		
Dillsboro	15,000		
Lee	15,000		
Sylva	30,000		
McDowell:			
Marion	50,000		6
Nebo	10,000		6
Old Fort	20,000		6
Macon: Franklin	100,000		
Madison: 2 townships	20,000		
Martin:			
Robersonville	50,000		
Williamston	40,000		
Moore:			
Carthage	8,000		6
Deep River	12,500		
Greenwood	10,000		
McNeills	14,000	10–30	5–5½
Moore—Continued.			*Per ct.*
Mineral Springs	$10,000		
Sand Hill	10,000		6
Nash:			
4 townships	40,000		
Manning	50,000		
Onslow: Jacksonville	10,000		
Orange: Hillsboro	40,000		
Pitt: Greenville	50,000	40	5
Polk: Tryon	12,000		
Richmond:			
Beaver Dam	10,000		
Black Jack	5,000		
Marks Creek	15,000		
Mineral Springs	5,000		
Rockingham	25,000		
Steeles	15,000		
Wolfs Pitt	25,000		
Scotland:			
Laurel Hill	30,000	30	4
Spring Hill	20,000		4
Stewartsville	50,000		
Williamson	30,000		
Stokes:			
Danbury	15,000	30	6
Meadows	40,000	30	6
Sauratown	50,000	30	6
Surry: Mount Airy	85,000	30	5
Warren: Warrenton	50,000		
Wayne:			
Brogden	40,000		
Goldsboro	100,000		
Wilson: Wilson	100,000		
Total	2,751,300		

OHIO.

Adams: Wayne	$7,000		4
Ashland:			
Montgomery	[1] 98,000		
Sullivan	25,000	10–18	5
Troy	70,000	10–18	5
Athens:			
Canaan	1,000	2–4	5
Trimble [2]	20,000		
Belmont:			
Colerain	25,000		
Pease	88,000		5
Pultney	25,000		
Warren	33,000		
Washington	40,000		
York	32,000	16	5
Columbiana:			
Perry	25,000	[3]	5
St. Clair	20,000	23	5
Crawford: Townships	355,500	8–20	4–6
Cuyahoga:			
Bedford	33,500		5–8½
Brecksville	19,000	15	4½
Brooklyn	7,000	10	5
Dover	35,829		4½
Euclid	32,161	24	4½
Independence	5,000		4½–5
Mayfield	8,500		4½
Olmsted	30,500		4½
Orange	32,600		4½
Parma	16,000		4½
Rocky River	30,900	8–16	4–4½–5
Royalton	19,725		4½–5
Solon	14,000		4½
South Newburgh	35,500		5
Strongsville	10,500	1–8	4½
Cuyahoga—Contd.			
Warrensville	10,000		
West Park	5,000		
Erie: Groton	25,000		4½
Fulton: 12 townships	392,200		5
Geauga: Hambden	3,000	6	4
Hamilton: Springfield	17,500		4½
Harrison:			
Short Creek	9,000		5
Stock	2,700		4–6
Henry: Ridgeville	2,500		6
Huron:			
Bronson	15,500	[3]	5
Greenfield	4,800	[3]	6
Greenwich	64,000	[3]	4½
Lynne	28,000	[3]	4½–5
New Haven	50,000	5	4½
New London	40,000		4½
Norwalk	25,000		
Norwich	46,000		4–5
Peru	15,000	[3]	4½
Richmond	31,000		6
Ridgefield	35,000		5
Sherman	40,000	10	5
Wakeman	27,500		4–4½
Jefferson: Springfield	25,000	29	4½
Knox: Hillar	10,000		
Lake:			
Painesville	7,500		6
Willoughby	38,000		4½
Lorain:			
Brighton	14,000		5
Columbia	24,000		4½
Grafton	40,000		5
Huntington	11,500		5
Rochester	20,000		4½

[1] Flood bonds issued without vote. [2] Bridge bonds. [3] Serial.

TABLE 23.—*Township highway and bridge bonds*—Continued.

OHIO.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Lucas:			
Monclova	$8,000	.....	5
Springfield	2,000	2	6
Mahoning:			
Canfield	100,000	25	4½–5
Ellsworth	18,500	.....	4½
Poland	115,000	.....	4½
Smith	100,000	.....	4½
Springfield	90,000	.....	.....
Marion: Tully	40,000	.....	.....
Medina:			
Brunswick	22,500	.....	5
Guilford	64,000	.....	4½
Hinckley	20,600	20	5
Liverpool	19,000	12	5
Medina	127,500	.....	4½
Miami:			
Brown	1,200	(1)	5
Concord	7,000	.....	.....
Newberry	2,000	.....	5
Montgomery:			
Clay	30,000	5	5
Van Buren	10,000	.....	5
Noble:			
Caldwell	6,000	15–19	6
Noble	20,000	.....	4–5
Olive	20,000	.....	5
Ottawa:			
Allen	37,000	.....	.....
Bay	24,450	.....	5
Catawba	20,000	.....	5
Danbury	25,200	.....	5
Erie	22,000	7–15	5
Harris	45,200	25	5
Perry: Coal	19,000	.....	6
Pickaway:			
Derby	17,000	.....	.....
Jackson	18,000	.....	.....
Portage:			
Aurora	4,000	.....	.....
Brunfield	6,900	.....	.....
Ravenna	9,000	2–10	4
Richland:			
Cass	35,000	.....	4½–5
Plymouth	61,000	.....	5
Sharon	50,000	.....	5–6
Weller	42,000	.....	4–5
Sandusky:			
Ballville	12,000	.....	4
Madison	3,100	.....	4½
Scioto: Porter	$10,000	9–19	4½
Seneca:			
Adams	10,000	10	5
Big Spring	60,500	.....	4½
Bloom	72,500	10	4½
Eden	66,000	13	4½
Hopewell	38,000	.....	4½
London	11,000	.....	.....
Scipio	27,000	.....	4
Seneca	47,000	.....	4
Stark:			
Canton	26,000	.....	5
Lexington	10,000	.....	4
Sugar Creek	14,000	.....	5
Washington	4,000	.....	5
Summit:			
Coventry	10,000	.....	.....
Hudson	10,000	.....	4½
Richfield	5,000	.....	5
Stowe	8,000	.....	4½
Twinsburg	7,000	.....	4½
Trumbull:			
Bristol	3,000	.....	6
Fowler	10,000	.....	5
Liberty	100,000	.....	5
Lordstown	100,000	3	4
Newton	47,500	.....	.....
Vienna	25,000	.....	5
Tuscarawas:			
Mill	10,000	5	5
Perry	1,200	3	5
Van Wert:			
Harrison	125,000	25	4–4½
Jennings	21,000	.....	4
Liberty	144,000	.....	4–4½
Pleasant	131,000	.....	4–4½
Ridge	125,000	.....	4–5
Tully	75,500	23	4–5
Willshire	140,000	.....	4
York	110,000	.....	.....
Vinton: Vinton	540	.....	4
Williams: Brady	35,000	.....	4½
Wood: Liberty	50,000	5	4–5–6
Wyandot: Tymochtee	46,000	10	4½–5
Total	5,283,805	.....	.....

OKLAHOMA.

Carter:			
Berwyn	$15,000	15	6
Morgan	40,000	.....	.....
Wilson	10,000	.....	.....
Creek: Sapulpa	50,000	20	5
Kay: Miller	18,000	.....	.....
Osage:			
Bigheart	50,000	.....	.....
Big Hill	50,000	.....	.....
Strike Ax	50,000	.....	.....
Rogers:			
Catoosa	$3,000	25	6
Verdigris	14,288	25	6
Stephens: King	27,500	15	6
Tulsa: Red Fork	50,000	.....	.....
Wagoner: Stonebluff	4,500	.....	.....
Total	382,288	.....	.....

[1] Serial.

TABLE 23.—*Township highway and bridge bonds*—Continued.

PENNSYLVANIA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Allegheny:			
Mifflin	$18,000	20	5
Reserve	21,000	.....	4½–5
Scott	10,000	8	4½
Stowe	20,000	.....	4½
Union	13,000	.....	5
Versailles	3,500	.....	5
Armstrong:			
East Franklin	4,300	17	4½
Kiskiminetos	5,500	20	5
Manor	5,000	.....	5
Beaver:			
Big Beaver	5,000	9	5
Chippewa	1,850	.....	6
Dougherty	5,412	.....	6
White	1,000	4	6
Bedford:			
Bloomfield	4,000	5	4
Liberty	400	.....	4
South Woodbury	9,500	4–10	4–5
Berks:			
Alsace	800	.....	.....
Richmond	1,500	1	5
Blair:			
Greenfield	5,800	.....	4½
Logan	35,000	.....	5
Taylor	4,500	20	4½
Bradford:			
Armenia	385	3	5–6
Terry	450	.....	.....
Warren	800	1	4
Bucks:			
Bristol	38,333	.....	4
Middletown	50,000	.....	4
Southampton	50,000	.....	4
Butler:			
Adams	3,000	6	5
Butler	5,500	15	4½
Cambria: Middle Taylor	1,250	.....	6
Cameron:			
Grove	1,600	8	6
Lumber [1]	2,200	3	5–6
Shippen	8,000	10	6
Carbon: Penn Forest	3,800	.....	5–6
Center:			
College	2,000	.....	5
Gregg	900	.....	5
Haines	500	.....	5
Half Moon	700	.....	4½–5
Chester:			
East Brandywine	2,100	.....	4–5
East Coventry	7,200	.....	4½
East Goshen	34,500	.....	4
New Garden	7,200	30	5
New London	2,000	.....	5
Penn	3,000	.....	5
Pennsburg	11,000	.....	5
Tredyffrin	12,000	9	4½
Valley	2,300	.....	5
West Brandywine	2,000	.....	4½
West Calm	5,000	.....	5
West Goshen	2,500	.....	4½
Willistown	40,000	.....	4
Clarion: Licking	400	.....	6
Clearfield:			
Bell	5,000	.....	5
Burnside	2,000	5	5
Cooper	1,000	.....	6
Decatur	5,000	.....	5
Ferguson	500	.....	.....
Gulich	3,795	.....	.....
Jordan	750	.....	.....
Lawrence	4,900	.....	5½
Penn [1]	2,000	.....	.....
Clinton:			
Dunnstabler	1,400	.....	5
Clinton—Contd.			
Leidy	$12,500	10	5
Logan	150	.....	4½
Columbia: Mount Pleasant	250	.....	4
Crawford:			
Oil Creek	1,700	5	5
Wenango	1,960	6	5–6
Cumberland: Lower Allen	2,350	.....	5
Dauphin: Jefferson	583	.....	5
Delaware:			
Ashton	12,000	.....	4
Darby	3,500	.....	5
Edgemont	11,000	.....	4½
Middleton	13,000	.....	4
Nether Providence	60,000	.....	6
Tinnicum	32,000	.....	5–6
Upper Chichester	3,400	.....	5½
Upper Darby	99,800	20	4½–5
Elk:			
Benzinger	3,450	.....	5
Ridgway	29,000	.....	6
Franklin: Lurgan	1,000	.....	5
Fulton: Brush Creek	5,000	.....	5–6
Huntingdon: Springfield	365	.....	6
Indiana:			
Conemaugh	8,500	.....	5
Pine	447	.....	6
White	9,000	.....	5
Juniata: Greenwood	200	.....	5
Lackawanna:			
Covington	1,500	.....	6
Jefferson	1,100	.....	6
Lehigh: Whitehall	65,000	20	4
Luzerne:			
Hunlock	2,300	.....	6
Plains	45,000	15	5
Plymouth	15,000	.....	5
Wilkes-Barre	40,000	.....	5
Lycoming:			
Hepburn	3,000	.....	5
Lewes	600	.....	5
Nippenose	2,380	.....	6
McKean:			
Annin	2,200	.....	6
Ceres	3,000	.....	5
Eldred	1,600	.....	5
Foster	6,300	2	6
Hamlin	4,108	.....	.....
Otto	1,028	.....	6
Mifflin: Derry	10,000	.....	4
Monroe:			
Jackson	650	.....	.....
Middle Smithfield	2,000	.....	5–6
Paradise	2,000	5	5
Pocono	2,785	.....	4–5
Polk [1]	500	.....	4
Smithfield	7,000	.....	5
Stroud	6,489	.....	.....
Montgomery:			
Abington	290,000	.....	4–4½–5
Cheltenham	155,000	.....	3–4
E. Norriton	4,500	.....	5
Horsham	25,000	.....	4½
Lower Gwynedd	16,000	23	4½
Montgomery	8,000	.....	4½
Springfield	20,000	10	4½
Upper Dublin	85,000	3	4½
Upper Providence	9,000	.....	4½
W. Norriton	12,500	20	4–4½
Worcester	22,500	.....	4–4½
Perry:			
Jackson	840	.....	5
Toboyne	200	.....	5

[1] Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds*—Continued.

PENNSYLVANIA—Continued.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per ct.
Pike:			
Greene	$3,500	7	5
Lehman	1,700	.....	6
Palmyra	1,200	.....	5
Potter:			
Bingham	704	.....	6
Clara	973	.....	6
Eulalia	4,752	.....	5
Hector	2,500	.....	6
Oswego	1,300	.....	5
Pike	8,774	.....	5½
Portage	1,500	.....	6
Stewardson	2,021	.....	6
W. Branch	2,700	.....	5
Schuylkill:			
Delano	500	.....	5
E. Brunswick	1,600	.....	6
N. Manheim	6,323	.....	6
Rush	3,000	.....	4
Sullivan:			
Colley	492,468	.....	.....
Forks	800	.....	6
Susquehanna:			
Apolacon	1,278	.....	6
Auburn	400	.....	4
Brooklyn	6,000	.....	.....
Forest Lake	1,500	.....	5
Jackson	213	.....	5
Tioga:			
Brookfield	3,769	4	5
Tioga—Continued.			
Deerfield	$5,100	5	5
Morris	3,357	7	6
Nelson	4,410	.....	5–6
Shippen	3,332	.....	5
Tioga	3,014	.....	6
Union: Hartley	1,275	.....	3–4
Venango: Allegheny	1,200	.....	.....
Warren:			
Conewango	6,600	.....	6
Corydon[1]	1,000	.....	5
South West	20,000	.....	6
Spring Creek	600	.....	6
Washington:			
Hanover	3,636	.....	.....
Independence	20,000	.....	6
Wayne:			
Cherry Ridge	500	.....	6
Dreher	4,000	.....	4
Lehigh	1,600	.....	5
Westmoreland:			
Ligonier	8,000	.....	5
N. Huntingdon	1,500	.....	6
Wyoming: Northumberland	1,200	.....	6
Windham	550	.....	5
York: Fawn	6,000	.....	5
Total	2,333,609	.....	.....

RHODE ISLAND.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per cent.
Washington: South Kingston	$265,000	.....	.....
Total	265,000	.....	.....

SOUTH DAKOTA.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per cent.
Stanley: Ashcreek	$3,500	5	6
Total	3,500	.....	.....

VERMONT.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per cent.
Addison: Middlebury	$1,500	.....	.....
Bennington: Bennington Center	10,000	1–13	5
Franklin:			
Berkshire	771	.....	.....
Sheldon	1,050	.....	.....

[1] Bridge bonds only.

TABLE 23.—*Township highway and bridge bonds*—Continued.

VERMONT—Continued.

Counties and towns.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
Grand Isle:			*Per cent.*
Grand Isle	$1,000		
Isle La Motte	2,000		
North Hero	1,000		
Total	17,321		

WISCONSIN.

Counties and townships.	Total amount voted to Jan. 1, 1914.	Term of years.	Interest rate.
			Per cent.
La Crosse: Onalaska	$11,000	10	5
Sauk: Delton	16,000		
Total	27,000		

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913.*

ALABAMA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Blount				$150,000		
Crenshaw				125,000		
Dallas	$100,000	30	5			
Hale	100,000					
Lawrence	123,000	30	6			
Marion				100,000	20	5
Marshall				130,000	30	5
Perry	110,000	30	5			
Russell	100,000	30	5			
Total	533,000			505,000		

ARKANSAS.

Benton				$2,815	12	
Montgomery				10,000		
Woodruff: District 1				30,000	20	6
Total				42,815		

CALIFORNIA.

Kern				$2,500,000	25	5
Orange	$1,370,000		5			
Plumas	100,000	10–25	4			
Riverside				1,500,000		
San Mateo				1,250,000	40	5
Santa Barbara: Carpinteria	50,000	20	6			
Total	1,520,000			5,250,000		

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

DELAWARE.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Kent				$30,000	20	5
New Castle	$105,000		4	[1] 475,000	20–51	4½
Sussex				30,000	5–24	4½
Total	105,000			535,000		

FLORIDA.

Bradford: Hampton				$25,000	20	6
Dade	$250,000					
De Soto				250,000		
Franklin	20,000	20	4½			
Hernando				100,000	30	5
Hillsborough				1,000,000	30	5
Holmes: 1 district				40,000	30	6
Lake				500,000	[2] 15–30	6
Orange	200,000			600,000	30	5½
Palm Beach	200,000					
Pasco				150,000	30	5
Pinellas	370,000	30	5			
Polk: Winterhaven	130,000					
Walton	70,000					
Total	1,240,000			2,665,000		

GEORGIA.

Bleckley				$8,000	30	5
Colquitt				400,000		
Total				408,000		

IDAHO.

Ada				$200,000	10–20	5
Bear Lake	$45,000	20	5½			
Boise	70,000					
Canyon	47,620	10	5			
Fremont: District 1				120,000	10–20	6
Gooding				160,000		
Lincoln:						
Shoshone	80,000	10–20	6			
Richfield				50,000	10–20	6
Twin Falls				[3] 100,000	10–20	5½
Total	242,620			630,000		

[1] Bridges, $250,000. [2] Serial. [3] Bridges, $50,000.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

ILLINOIS.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Carroll	Woodland [1]				$1,200		5
	Wysox				3,500	1–5	5
Crawford	Honey Creek	$25,000			35,000	20–25	5
	Lamott	20,000			35,000	20–25	5
	Oblong				35,000	20–25	5
	Robinson	25,000					
Dekalb	Malta	8,500	2	5			
Douglas	Boudre	35,000	13				
	Sargent	35,000	2–7	5			
Edgar	Elbridge	2,500		6			
	Embarrass	35,000	10	5			
Edwards: District 3					3,000	2	6
Fulton	Orion	7,000		5			
Gallatin	Bowlesville	1,000	1–2	4			
	Shawnee	7,000	1–5	4			
Jackson	Carbondale	35,000	3–5	5			
Jefferson	Blissville [1]	500			500		
	Farrington [1]				500		
Kankakee	Ganeer	35,000					
	Momence	35,000					
	Yellowhead	35,000					
La Salle	Farm Ridge				2,000	1	5
Lawrence	Dennison				35,000	3	5
Lee	Ashton	22,000	20	5	22,000	20	5
	China	25,000					
	Harmon				3,000		
	Viola				13,000	1–13	5½
Pike	Derry	3,075		5½			
	Hadley	525					
	Hardin	1,200					
	Kinderhook	700					
	Pleasant Hill	1,200					
St. Clair	Centerville	2,500					
	Fayetteville	2,000					
Sangamon	Salisbury	6,000	5	5			
Stephenson	Jefferson	3,000					
Wayne	Leech [1]				4,000	5	6
	Massilon [1]				3,125	5	6
Whiteside	Sterling	16,000					
Will	Crete				35,000	13	5
	Custer				3,000	3	5
Total		424,700			233,825		

INDIANA.

Adams					$151,550	10	4½
	Blue Creek				15,120	(2)	4½
	French				5,280	(2)	4½
	Hartford				8,240	(3)	4½
	Kirkland				10,160	(2)	4½
	Monroe				25,440	(2)	4½
	Preble				6,560	(2)	4½
	Root				17,120	(2)	4½
	St. Marys				6,400	(2)	4½
	Wabash				32,940	(2)	4½
	Washington				69,740	(2)	4½
Allen					53,840	10	4½
	Jackson	$36,320	1–20	4½			
	Lafayette	22,800	1–20	4½			
	Madison	35,930	1–20	4½			
	Maumee	30,842	1–20	4½			
	Monroe	8,240	1–20	4½			
Bartholomew	Townships	82,062			79,216	[3] 10–20	4½
	Clifty	11,520	10	4½			
	Flat Rock	5,000	10	4½			
	Haw Creek	16,500	10	4½			

[1] Bridge bonds only. [2] Six months. [3] Serial.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

INDIANA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Benton					$111,560		4½
	Grant				11,156	10	4½
	Hickory Grove				2,926	10	4½
	Richland				1,643	10	4½
Boone		$14,040			39,640	10	4½
	Perry	6,000	10	4½			
	Sugar Creek	2,400	10	4½			
	Townships				9,378		
Carroll	Townships	139,000			42,400		
Cass: Districts 1–3					112,425	10	4½
Clark	Bethlehem	9,440	10	5			
	Carr	13,700	10	5			
	Charlestown	43,400	10	5			
	Jeffersonville	38,100	10	5			
	Monroe	29,506	10	5½			
	Union	14,316	10	5			
	Washington	17,948	10	5			
	Wood	9,010	10	5			
Clay					73,800	10	4½
	Perry	9,000		4½			
Crawford	Ohio	6,824		4½			
Daviess					90,000	10	4½
	Madison				56,738	10–20	4½
	Reeve				21,000	1–20	4½
Dearborn		66,063			40,000	1–20	4½
	Center				40,000	20	4½
	Harrison	11,320	1–20	4½			
	Miller				50,000	10–20	4½
Decatur					[1] 63,880	10–15	4½
Delaware					100,000	10–20	4½
Fayette					24,000	10	4½
Fountain		122,750			15,200	10	4½
Gibson					77,300	10	4½
	Center				5,600	10	4½
	Montgomery				26,400	10	4½
	Patoka				18,000	10	4½
	Union				27,300	10	5½
Grant	Townships	550,000	10	4½			
Greene					42,499	10	4½
Hamilton	White River	6,320					
Hancock					[2] 35,500	1–10	4½–6
Harrison					43,220	20	4½
	Harrison	7,100		4½			
	Taylor	9,200					
Henry		10,200		4½			
	Franklin	9,200		4½			
Howard	Union				215,000	10	4½
Huntington		52,988	10	4½	39,653	10	4½
	Jackson				22,425	10	4½
Jackson					[3] 29,640	10	4½
Jasper	Hanging Grove	5,800	10	4½			
	Keener	18,000	10	4½			
	Townships				68,910	10	4–6½
Jay					50,370	10	4½
Jefferson	Township				3,000	20	4½
Jennings					14,300	10	4½
Johnson	Townships				93,400	10	4½
Knox	Vincennes				189,360	10	4½
Kosciusko		1,440	10	4½			
Laporte					208,000	20	4½
Madison		99,380	10	4½			
3 districts					76,120	[4] 10	4½
	Fall Creek				6,240	20	4½
Marion					[5] 228,000	10–20	4½
Marshall					57,000	15	4½
	Bourbon	28,500	15	4½			
Martin		30,000			4,300		4½
	Baker	5,092	12				
Miami		32,550	10–20	4½	70,880	10–20	4½–5
Monroe		96,319					
Morgan		21,000	10	4½	48,200	10	4½
Ohio					9,000	10	5

[1] Bridge bonds, $30,000.
[2] Bridges, $25,000.
[3] Bridge, $15,000.
[4] Serial.
[5] Bridge, $200,000.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

INDIANA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Owen					$24,159	20	4½
	Marion	$8,972	40	4½			
Parke	Adams				22,658	10	
Perry	Troy	73,000	20	4½			
Pike	Townships				21,000	20	6½
Putnam: Districts 1–3					58,689	10	4½
Rush					259,000	10–20	4½
	Walker	39,800		4½			
St. Joseph		60,000	16	4	24,000	10	4½
Scott	Jennings	8,000	10	4½			
Shelby [1]					80,000	20	4½
	Shelbyville	51,940		4½	28,920	20	4½
Spencer	Ohio	14,320					
Starke					41,000	10	4½
Sullivan					80,982	10	4½
	Jackson	17,960		4½			
Switzerland		22,931	10	4½			
Tippecanoe [1]					260,000	10	4½
Tipton: Districts 1–3					44,080	10	4½
Vanderburg					92,600	10	4½
Vigo					33,800	(2)	4½
Wabash					145,320	10	4½
	Liberty				10,960	10	4½
	Noble				67,540	10	4½
	Pawpaw				12,660	10	4½
Wayne	Green	12,000					
	4 townships				58,660	10	4½
	Wayne	127,500			146,000	10	4½
Wells		105,640					
White		57,600			93,000	10	4½
Total		2,384,783			4,701,997		

IOWA.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Boone	$25,450	12	4½			
Dallas				[3] $67,000		
Fremont [1]				[4] 100,000	20	5
Jackson [1]				[5] 108,000	20	5
Madison				28,000	[2] 3–17	5
Wright [1]				45,000	7–15	5
Total	25,450			348,000		

[1] Bridge bonds only.
[2] Serial.
[3] General funding bonds including gravel roads.
[4] By order of Board of Supervisors.
[5] To fund outstanding bridge warrants.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

KANSAS.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Geary		$86,150	10	6			
	Junction City	89,600	9–10	5–6			
Kiowa	Glick	5,000	(1)	5			
Marion					$6,000	5–11	6
Sedgwick					1,550	10	5
Wilson	Center	7,000					
	Guilford	10,000					
Wyandotte		189,000	(2)	4½			
Total		386,750			7,550		

KENTUCKY.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Lewis				$800		
Robertson	$8,000	5–8	5			
Total	8,000			800		

LOUISIANA.

Parishes [3] and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate
			Per cent.			*Per cent.*
Assumption				$80,000	9	5
Bossier				175,000	1–40	5
Calcasieu				900,000	25	5
East Baton Rouge: District 1				37,000	10–20	5
Iberville: Districts 1, 5, and 6	$13,009	1–10	10			
Jefferson	200,000		5			
Lafayette				75,000	25	5
Tangipahoa: District 2				75,000	30	5
Washington				39,477	2–4	5½
Total	213,009			1,381,477		

MAINE.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Kennebec	Benton				$1,500	5	4
Knox	Vinal Haven				2,500		
Oxford	Norway [4]				35,000	35	4
Penobscot	Orono [5]				12,000	2–4	4
Piscataquis	Foxcroft	$25,000	1–25	4			
Waldo	Frankfort [5]				1,000		5
Washington	Jonesport				1,000	(6)	6
Total		25,000			53,000		

[1] Serial to run until 1918.
[2] Serial to run from 1932 to 1941.
[3] Parishes are equivalent to counties.
[4] For roads and sewers.
[5] Bridge bonds.
[6] Six months.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

MARYLAND.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Caroline				[1] $35,000	20	5
Montgomery: 5 districts	$47,000			25,000	25	4½
Queen Annes	50,000					
Talbot				30,000		
Worcester				25,000	25	5
Total	97,000			115,000		

MASSACHUSETTS.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Barnstable [2]					$14,000		
Berkshire					5,000	1–2	4
Bristol	North Attleboro	$6,000	1–6	4	7,000	1–3	4½
Essex					120,000		
Hampden	Russell	5,000		4			
Middlesex	Billerica	9,000					
Nantucket					20,000	5	4
	Nantucket	20,000	10	5			
Norfolk [2]					50,000	([3])	4.92
	Millis	2,400	3	4			
Plymouth [2]					20,000		4
Total		42,400			236,000		

MICHIGAN.

Antrim	Banks				$20,000	[4] 20	5
	Central Lake				20,000		
Baraga	Arven	$10,000					
Benzie	Crystal Lake				20,000		
Berrien					500,000	15	4
	3 townships				89,000		
Delta		100,000	([1])	4½			
Emmet					225,000		
Genesee		500,000	20	4½	200,000	[4] 10	4½
Gogebic		150,000	10	4½			
Grand Traverse	Paradise	30,000					
	Whitewater				24,000		
Huron	Sebewaing	75,000					
	Windsor	50,000					
Ingham					63,652		
Kalkaska	Clearwater	6,000					
	Coldspring	5,000					
	Springfield	9,000					
Kent					265,000	20	4½
Lake	Ellsworth	6,000	5				
Leelanau	Leelanau	20,000					
	3 townships				26,000		

[1] Bridge built from part of this amount.
[2] Bridge bonds only.
[3] Nine months.
[4] Serial.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

MICHIGAN—Continued.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Mackinac					$100,000	10–20	5
	Hudson	$4,000					
	Newton	5,000					
Macomb	Lake	50,000					
	Warren	36,000					
Mason	Free Soil	10,000					
Midland					56,000	15	5
Montcalm	Eureka	500	10	5			
Newago	Groton				20,000		
Oceana	Golden	3,000		5			
Ontonagon					38,000	[1] 10	5
Osceola	Lincoln				5,000		
Ottawa		600,000	20	4½			
Tuscola	Fairgrove				20,000		
	Wellington				4,500		
Van Buren	Covert				25,000		
	South Haven	25,000	5	5			
Wexford	Henderson	2,000					
Total		1,696,500			1,721,152		

MINNESOTA.

Beltrami					$81,000	20	4
Carlton	Blackhoof	$3,000	15	4			
	Corona	1,500	15	4			
	Mahtowa	3,000	20	4			
	Red Clover	2,000	13	4			
	Split Rock	3,000	13	4			
Kittson	Thompson	7,000		4			
Koochiching	Bannock	3,000	10	4			
	Meding	7,000	10	4			
	Reedy	6,000	10	4			
McLeod	Collins	3,000	6–15	4			
Marshall	Alma	1,200	5–9	4			
	Big Woods	800	5	8			
Millelacs	Page	5,000	9	4			
Ramsey	White Bear	7,500		4			
Winona					50,000	5–7	5
Total		53,000			131,000		

MISSISSIPPI.

Counties and beats.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Adams: Beat 1	$150,000					
Attala	50,000	25	5			
Calhoun	40,000	25	6			
Beat 1	60,000	25	6			
Chickasaw: Beat 3	50,000	20	5	$150,000	20	5
Claiborne				10,000	20	5
Clay:						
Beats 1–3	141,000					
Beat 2				20,000	10–25	6
Coahoma	50,000	30	5			
Copiah	159,000					
Beat 2				75,000	25	6
Covington	50,000					
De Soto: Beats 1, 2, 3, and 5	250,000					
Forrest	100,000	10–25	5			
Beats 1 and 3				100,000	40	5

[1] Serial.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

MISSISSIPPI—Continued.

Counties and beats.[1]	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
George	$30,000	30	6			
Greene				$10,000	1–10	6
Grenada	45,000	20	5			
Hancock	100,000	20	6	50,000	20	6
Hinds: Beats 1 and 5				200,000	25	5
Issaquena				20,000	40	6
Itawamba				65,000		
Jackson	65,000					
Jasper	25,000	25	5			
Jones: Beat 2				50,000	25	5
Lafayette	180,000	25	5½–6			
Lamar	51,000			20,000		
Lauderdale: Beat 5	50,000	30	5	100,000	30	5
Lee:						
Beats 1 and 3	50,000	25	5½			
Beats 1 and 2				80,000	25	5½–6
Leflore				100,000	20	5
Lowndes: Beat 2				50,000	10–20	5
Monroe: Beats 1, 4, and 5	50,000	25	5			
Montgomery: Beat 1	40,000	10–20	5			
Neshoba				100,000		
Noxubee				380,000		
Beats 1, 2, 3, and 5	377,500	25	5½			
Panola				50,000		6
Pike				200,000		
Pontotoc				5,000	20	
Prentiss: Beat 1	50,000	20	6	40,000	25	6
Quitman				25,000		
Rankin: Beat 2				10,000		
Scott: Beat 1	75,000	20	6			
Simpson: Beats 1 and 2				40,000	20	5½
Tallahatchie	25,000	25	6			
Beats 1–5				75,000	25	6
Warren	65,400	20	5	300,000		
Yalobusha:						
Beats 1 and 4	25,000	25	5½			
Beats 2 and 4				48,000	25	5½–6
Yazoo: 4 beats				77,500	25	6
Total	2,403,900			2,450,500		

MISSOURI.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Boone: Harg		$20,000	10	6			
Cedar		19,000	2–15	5½			
Clay: 2 districts		135,000					
Dade: 1 district		30,000					
Greene		12,000			$78,000		
Grundy					5,000		6
Howell		30,000					
Laclede		50,000					
Lawrence: Mount Vernon		50,000	15	5			
Mississippi: 1 district		7,000					
New Madrid: King's Highway and Malden Risca		20,000					
Newton: Neosho					30,000	15	6
Nodaway		15,000	(2)	6			
	Polk[3]				50,000		
Stone: 1 district		10,000	17	6			
Total		398,000			163,000		

[1] Counties subdivided into beats and districts. [2] Serial. [3] Bridge bonds only.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

MONTANA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Blaine	$40,000	20	5			
Cascade	60,000					
29 districts[1]				$45,000	20	5
Custer	170,000	20	4½			
Lincoln	125,000	20	5			
Musselshell	80,000	20	5			
Sanders: 20 districts				15,000	[2] 5–20	5
Teton	100,000	5–20	5			
33 districts				[3] 100,000	20	5
Total	575,000			160,000		

NEBRASKA.

Lincoln				$15,000		
Scotts Bluff: Precincts	$10,000	20	5			
Total	10,000			15,000		

NEW JERSEY.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Atlantic		$30,000					
	Egg Harbor	30,000	8–13	4½			
Bergen		11,000	30	4½			
Camden		57,000	5	4½			
Cape May		53,500	30	4½	$70,000	30	4½
Cumberland		9,000	9	4½			
Essex		100,500	40	4			
Gloucester		130,000	1–13	4½			
Hudson		320,666		4–4½			
Hunterdon		45,000	25	4	84,000	30	4
Mercer		40,500	20–30	4	14,500	30	4½
Middlesex		48,000		4½	143,500		
Ocean					35,000	30	5
Passaic					[4] 136,000	14–18	5
Sussex		17,600					
Warren					30,000	5–10	4
Total		892,766			513,000		

NEW MEXICO.

County.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Dona Ana				$100,000	32	5

[1] Bridge bonds only. [2] Serial. [3] Bridges, $30,000. [4] Bridge, $26,000.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

NEW YORK.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Cayuga					$29,777	1–20	4½–5
Chautauqua	French Creek	$3,000	3	4½			
	Kiantone	4,000	4				
Chemung	Big Flats	7,000		4½			
	Chemung	20,000		4½			
	Elmira	3,408		4½			
Essex	Chesterfield	1,500					
	Keene	3,000					
Fulton	Caroga	35,000	6	5			
Greene		45,500					
Herkimer	Fairfield				5,000		
	Frankfort	2,765	4	5½			
	German Flats	6,000					
	Herkimer [1]	20,732	11	4⅓	67,500		4.6
	Manheim	19,771	12	4½			
	Newport	8,000	16	4			
	Russia	3,000					
	Salisbury	5,900	5	5			
	Schuyler	12,530					
	Webb	17,000	19	5			
Lewis		12,362	25	5			
	Lowville	9,000					
Livingston					12,750	4	4¾
Nassau		240,000	5–20	4½	500,000	6–20	4½–4.7
Niagara					4,000		
Oneida	Kirkland	5,400					
Orleans		21,750	6	5			
Otsego	Maryland	3,000					
	Westford	2,500					
Putnam					38,000	15	4¾
Rensselaer		150,000			81,000		
St. Lawrence		125,000	4–9	4			
Schenectady	Princetown [1]				1,200		
Seneca					20,335	10	4.7
Steuben	Corning	4,000	2–5	5			
Suffolk					55,000	13½	4½
Tompkins		23,000	(1)	4½			
	Lansing	5,000	(1)	4½			
	Trumansburg	10,000					
Warren		50,000	11	5			
Westchester		89,560			[2] 30,000	20–25	
	Eastchester	46,500		4–5			
	New Castle	141,500					
	White Plains	30,000					
Total		1,186,678			844,562		

NORTH CAROLINA.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Anson		$50,000			$50,000		
Beaufort					[3] 50,000		
Brunswick					40,000		
Buncombe					50,000		5–6
Burke	Morganton				50,000		
Cabarrus		105,000					
Caldwell	Lovelady				25,000		
Carteret	Morehead				10,000	42	5
	Newport				3,000	42	5
Catawba	Hickory	50,000					
	Newton	50,000					

[1] Serial.
[2] Bridge bonds only.
[3] By act of legislature county commissioners have authority to sell bridge bonds without vote of people.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

NORTH CAROLINA—Continued.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Cherokee		$187,000					
Cleveland					$60,000	40	
	Townships	25,000	15	5	50,000		
Davie					175,000		
Duplin	Calypso	5,000					
	Faison	15,000					
	Rosehill	20,000					
	Wallace	5,000					
	Warsaw	20,000					
Edgecombe: Districts 1, 2, 3, 4, 5, 8, 9, 10, and 11					200,000	55	
Franklin	Franklinton	20,000	20	5–5½	20,000		
	Youngsville	15,000					
Granville		40,000					
Greene	Voted by all townships, except 3.				180,000		
Halifax	Enfield				60,000		
	Halifax				40,000		
Haywood	Waynesville	50,000		5			
Henderson		24,000			25,000		
	Edneyville				12,000		
	Hendersonville				50,000		
	Hoopers Creek				20,000		
Iredell		400,000					
Jackson	Cullowhee				30,000		
	Dillsboro				15,000		
	Sylva				30,000		
Lee		100,000	40	5			
Lincoln					200,000	40	
McDowell	Marion				50,000		6
	Nebo				10,000		6
	Old Fort				20,000		6
Macon	Franklin				100,000		
Madison					300,000		
	Township	10,000					
Martin	Robersonville				50,000		
Moore	Deep River				12,500		
	Greenwood				10,000		
	Mineral Springs				10,000		
Nash	Rocky Mount	20,000					
	Mannings				50,000		
New Hanover					[1] 350,000	25	
Onslow	Jacksonville				10,000		
Orange		250,000					
Pitt	Greenville				50,000	40	5
Polk					[2] 100,000	30	
Richmond	Beaver Dam	10,000					
	Black Jack	5,000					
	Marks Creek	15,000					
	Mineral Springs	5,000					
	Rockingham	25,000					
	Steeles	15,000					
	Wolf Pitt	25,000					
Rutherford					250,000	40	
Sampson		10,000			100,000	20	
Scotland	Stewartsville	50,000					
	Williamson	30,000					
	Laurel Hill	30,000	30	4			
	Spring Hill	20,000		4			
Stokes	Danbury				15,000	30	6
	Meadows				40,000	30	6
	Sauratown				50,000	30	6
Surry	Mount Airy	5,000	30	5	80,000		
Vance					200,000	20–40	
Warren	Warrenton				50,000		
Wayne	Brogden				40,000		
	Goldsboro				100,000		
Yancey					150,000		
Total		1,706,000			3,642,500		

[1] Including $250,000 for bridges.

[2] By act of legislature.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

OHIO.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Ashland					$194,000	10	5
	Sullivan				25,000	10–18	5
	Troy				70,000	10–18	5
Ashtabula					[1] 75,000		
Auglaize					[2] 78,000	13–26	5
Belmont	Washington	$40,000		5			
	York	14,000	16	5			
Coshocton					[3] 100,000	10	5
Cuyahoga		2,003,220	1–30		1,000,000	1–31	5
	Euclid	4,000	24	4½			
Defiance [4]					65,000	4–65	5
Erie	Groton	25,000		4½			
Fayette [4]					9,000	([5])	5
Fulton					30,000	5	5
Gallia					14,000	2–8	5
Hancock		120,500					
Henry					28,750	5	5
Highland: 2 districts					7,850	5	5
Huron	Norwalk	20,000					
	Ridgefield	20,000		5			
	Sherman	25,000	10	5			
Lake					62,000	20	4½
Lawrence					30,000	4½–5	
Licking		210,000			[6] 374,000	5–25	5–5½
Lorain: District 1					180,000	13	5
	Four townships	175,000					
Lucas		139,535					
Madison [4]					80,000	10	5
Mahoning	Springfield	40,000					
District 1					150,000	25	5
Mercer					54,600		5–5½
Miami					60,000		
Montgomery					330,000		5
Muskingum					[7] 875,000		5
Noble	Caldwell				6,000	15–21	6
	Noble	10,000		4–5			
Ottawa	Catawba	20,000					
	Danbury	8,400		5			
Paulding		24,000			134,300	7	5
Perry					45,000	10	5
Pike					14,000	2–13	5
Portage	Brumfield	6,900					
Putnam		155,000	5–10	5			
Ross					[8] 86,000	25–30	
Sandusky					[9] 37,650	5	5
Scioto					[10] 440,000		5
Stark					[11] 545,000	5–15	5
Summit [4]		40,000			23,000		
Trumbull					[12] 245,000		5
Districts 1 and 2		60,000					
	Vienna	25,000		5			
Tuscarawas: 68 districts					130,000	1–3	6
Union					53,600		
Van Wert					16,600	12–21	5
	Tully	15,900	23	4–5			
Warren [4]					262,000	1–30	4–5
Washington [4]					190,000	1–22	5–5½
Wayne [4]					20,000		
Williams [4]					5,000		5
Wood					[13] 156,000	5	5
Wyandot	Tymochtee	20,000	4½–5				
Districts					7,200	10	5
Total		3,221,455			6,308,550		

[1] Flood bonds.
[2] Bridge $70,000.
[3] Emergency road and bridge bonds.
[4] Bridge bonds only.
[5] Nine months.
[6] Bridge $24,000.
[7] Of this amount $775,000 for bridges.
[8] Bridge and refunding bonds.
[9] Bridge $25,000.
[10] Flood and emergency bonds, by authority of H. B. 640.
[11] Bridge $190,000.
[12] Bridge $85,000.
[13] Bridge $6,000.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

OKLAHOMA.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Carter	Berwyn				$15,000	15	6
Creek	Sapulpa				50,000	20	5
Rogers	Catoosa				3,000	25	6
	Verdigris				14,288	25	6
Stephens	King	$27,500	15	6			
Wagoner		75,000					
Total		102,500			82,288		

OREGON.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Clatsop				$400,000	20	5
Jackson				500,000	10–30	5
Multnomah[1]				1,250,000	1–30	5
Total				2,150,000		

PENNSYLVANIA.

Counties and districts.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Allegheny					$1,550,000	30	4½
Berks		$475,000	2–12	3½			
Cameron	Lumber	600	3	5–6			
	Shippen	3,000	10	6			
Carbon: Districts (55)					50,000	5	4
Lackawanna					200,000	15	4½
Luzerne					[2] 260,000	30	4½
McKean	Ceres	1,000		5			
	Hamlin	4,108					
Potter					25,000		5
Sullivan	Forks	800		6			
Washington					220,000	1–20	4⅜
Westmoreland					250,000	20	4½
York					35,000		
Total		484,508			2,590,000		

RHODE ISLAND.

County.	Town.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Washington	South Kingston	$100,000					

[1] Bridge bonds only.

[2] Bridge $100,000.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

SOUTH CAROLINA.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Laurens	$50,000		4½			
Marion	40,000		4½			
Richland	75,000		5½			
Total	165,000					

SOUTH DAKOTA.

Counties.	Township.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Pennington[1]		$44,000	1–10	5			
Stanley		13,500					
	Ashcreek	3,500	5	5			
Total		61,000					

TENNESSEE.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Benton				$200,000		
Bradley				25,000	25–30	5
Campbell[1]				4,000	1	
Carter	$12,944					
Dickson				250,000	30	5
Greene: 25 districts				500,000	30	5
Hamblen	25,000	40	5			
Hickman[1]				17,500	12½	5½
Jackson				100,000	30	5
Jefferson				150,000	30	
Loudon	100,000			150,000	30	5
Montgomery				120,000	30	5
Perry				14,500	7	5
Polk				330,000	30	5–6
Roane				110,000	30	5
Sevier: 17 districts				185,000		
Shelby				600,000	12	5
Sullivan	200,000	20–30	4½	30,000		
Sumner	200,000	30	4½			
Wayne	1,200					
White	90,000					
Total	629,144			2,786,000		

[1] Bridge bonds only.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

TEXAS.

Counties[1] and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Anderson	$150,000	20	5			
Atascosa				$20,000		
Austin: Districts 1–3	200,000	5–40	5			
Bastrop: Districts 1–2	100,000	20–40	5	80,000		
Baylor	100,000					
Bee	15,000	20	5			
Bell	7,960			3,980		
District 1				200,000	40	5½
Bexar				750,000	40	5
Bosque: District 7	40,000	40				
Brazoria: District 3	150,000	34	5½			
Brooks	45,000	40	5			
Calhoun				5,000	40	5
Districts 1 and 2	100,000	40	5	135,000		
Cameron				20,000		
Cass: District 7				35,000	40	5
Chambers	14,000					
District 1	6,000	20	5			
District 4				100,000		
Collin				450,000		
Comal				[2] 75,000	40	5
Cooke	1,190					
Crockett				40,000	40	5
Culberson				50,000	40	5
Dallas	5,000					
Denton: District 1	75,000	40	5			
Ellis	173,000					
El Paso	17,000			350,000		
Fort Bend	30,000			175,000		
Frio	1,990			80,000	40	5
Galveston				250,000	40	5
Garza				50,000	40	4
Gonzales: District 1	150,000		5			
Grayson				35,000		
Districts 1 and 2	400,000	40	5			
Gregg				50,000		
Grimes	125,000					
Guadalupe				1,600		
Harris: Districts 5 and 6	212,000	[3]	5			
Hill: Precinct 1				250,000	40	5
Houston: Districts 1 and 3	174,000					
Howard	100,000					
Irion				20,000	40	5½
Jim Wells				125,000	10	5
Johnson				75,000		
Jones				3,000	20	5
Kerr	20,000	5–40	5	40,000		
Kinney				80,000		
Lamar: Precinct 1				100,000	10–40	5
Leon:						
Districts 1–6	84,000					
District 7				50,000		
Liberty	225,000			200,000		
Limestone				150,000		
District 4	150,000	10–40	5			
Matagorda: Districts 1, 2, and 4				460,000		
McLennan: District 1	100,000	40	5			
Medina: District 4				40,000	40	5
Midland				50,000		
Milam: Districts 2 and 5				200,000	40	
Montgomery: District 1				100,000	40	5
Navarro: Districts 1 and 3				475,000	40	5
Nolan	15,000					
Nueces				165,000		
Orange	200,000					
Polk				40,000	4	5
Refugio	25,000			25,000		
Robertson	500,000	40	5			
Districts 1, 2, and 5				250,000		
San Saba				1,990		
Smith				376,250	40	5
Somervell: District 1	16,900					

[1] Counties subdivided into districts and precincts.
[2] Issued by commissioner's court.
[3] Serial.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

TEXAS—Continued.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Sterling				$10,000		
Tarrant	$1,600,000					
Tom Green [1]				70,000	10–40	5
Trinity: District 1				120,000	40	5
Walker				150,000		
Waller: Waller				15,000	40	5
Wharton: District 1	300,000	(2)	5			
Wood	120,000					
Zavalla				[3] 1,999	40	5
Total	5,748,040			6,598,819		

UTAH.

Counties.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Boxelder	$175,000	20	4½			
Grand [1]	8,500	20	5			
San Juan				$14,500	20	
Total	183,500			14,500		

VERMONT.

Counties.	Towns.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Addison	Middlebury				$1,500		
Bennington	Bennington Center				10,000	13	5
Franklin	Berkshire				771		
	Sheldon				1,050		
Total					13,321		

VIRGINIA.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per cent.			*Per cent.*
Accomac:						
Atlantic	$50,000		5			
Lee				$50,000		5½
Augusta: South River	250,000	30	5			
Brunswick	84,000		5			
Culpeper: Catalpa	120,000	(2)	5			

[1] Bridge bonds only.
[2] Serial.
[3] Issued by commissioner's court as emergency bonds.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

VIRGINIA—Continued.

Counties and districts.	1912			1913		
	Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
			Per ct.			*Per ct.*
Dickenson: Clintwood and Kenady	$54,000	2–30	5	$32,000	.....	.....
Fairfax: Mount Vernon	.....	.....	.....	90,000	.....	.....
King George	.....	.....	.....	10,000	.....	.....
Lee	.....	.....	.....	76,000	.....	5
Lunenburg: 3 districts	40,000	.....	6	64,000	.....	5½
Nelson	.....	.....	.....	35,000	32	5
Northampton:						
Eastville	50,000	.....	.....	.....	.....	.....
Franktown	20,000	30	4¾	.....	.....	.....
Orange	125,000	10–20	5	.....	.....	.....
Pittsylvania: Dan River	100,000	34	5	.....	.....	.....
Pulaski: Dublin	100,000	10–30	5	.....	.....	.....
Rappahannock	.....	.....	.....	64,000	.....	5
Rockingham: Plains	30,000	10	6	.....	.....	.....
Russell	.....	.....	.....	150,000	.....	5
Scott:						
Estillville	.....	.....	.....	100,000	20–30	5
Fulkerson	.....	.....	.....	33,800	20–30	5
Johnson	.....	.....	.....	33,300	20–30	5
Smyth: Marion and St. Clair	.....	.....	.....	225,000	.....	5
Spotsylvania: Berkeley and Livingstone	.....	.....	.....	100,000	30	5
Stafford	100,000	.....	.....	.....	.....	.....
Warren	.....	.....	.....	60,000	.....	5
Westmoreland	.....	.....	.....	25,000	.....	5
Wise	.....	.....	.....	260,000	30	5
Total	1,123,000	.....	.....	1,408,100	.....	.....

WASHINGTON.

Asotin	.....	.....	.....	$35,000	.....	.....
Clallam	$300,000	20	5	.....	.....	.....
Clarke [1]	.....	.....	.....	500,000	.....	.....
King	3,000,000	20	5	.....	.....	.....
Okanogan: District 1	15,000	10	10	.....	.....	.....
Snohomish: Delta	.....	.....	.....	75,000	.....	.....
Total	3,315,000	.....	.....	610,000	.....	.....

WEST VIRGINIA.

Hancock:						
Butler	$125,000	34	5	.....	.....	.....
Baxter and Grant	125,000	10–34	5	.....	.....	.....
Logan [1]	.....	.....	.....	860,000	20	5
Marion:						
Fairmont	.....	.....	.....	400,000	30	5
Mannington	.....	.....	.....	300,000	30	5
Marshall	150,000	34	5	.....	.....	.....
Pleasants: St. Marys	.....	.....	.....	60,000	30	5
Wetzel: Grant	.....	.....	.....	150,000	34	6
Wood: Parkersburg	180,000	30	4½	.....	.....	.....
Total	580,000	.....	.....	970,000	.....	.....

[1] Bridge bonds only.

TABLE 24.—*County, district, and township highway and bridge bonds voted during 1912 and 1913*—Continued.

WISCONSIN.

Counties.	Townships.	1912			1913		
		Amount voted.	Term of years.	Interest rate.	Amount voted.	Term of years.	Interest rate.
				Per ct.			*Per ct.*
Ashland		$25,000	20		$25,000	20	4
Columbia		20,000	20				
Iron		35,000	6	4			
La Crosse	Onalaska				11,000	10	5
Sauk [1]					24,000	20	4½
Vilas		60,000	20	5			
Total		140,000			60,000		

[1] Bridge bonds only.

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds.*

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.	
Alabama	Autauga	$65,000	100				100	
	Bullock	160,000	95	5			100	
	Dallas	410,000	44	137			197	Includes 16 miles graded.
	Elmore	170,000	55	56			111	
	Jackson	250,000		32	76		108	
	Marshall	130,000	35	30	10		75	
	Mobile	500,000					42	About 1 mile of bituminous concrete pavement; 5 miles of chert gravel and 36 additional miles in course of construction.
	Morgan	240,000	4	1	60		65	
	Pike	192,000	230				230	
	Russell	100,000	63.5	1.5			65	
	St. Clair	85,000		85			85	
Arizona	Yuma	500,000		150	50		200	
Arkansas	Woodruff: District 1.	30,000		6			29	23 miles of graded road.
California	Glenn	450,000		160			160	
	Kern	2,500,000		38.1	183.4		339.5	118 miles graded.
	Los Angeles	3,500,000				248	248	
	Orange	1,370,000				107	107	
	Sacramento	600,000				104	104	
	San Diego	1,250,000					450	Mostly surfaced with disintegrated granite; 44 miles concrete.
	San Mateo	1,298,000		20	48		112	44 miles not specified.
Delaware	New Castle	1,285,000	60	2.9	161.66	2.06	226.62	Of this amount $275,000 was used for bridges.
Florida	Columbia	40,000	86				86	
	Hillsborough	1,400,000					70	Brick.
	Manatee	250,000			64		64	
	Nassau	60,000					22	Shell.
	Orange	800,000					80	65 miles of brick; rest not specified.
	Pasco	150,000			30		30	
	St. Lucie	200,000					50	Rock 25 miles, marl 15 miles, and shell 10 miles.

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds*—Continued.

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.	
Georgia	Ben Hill	$75,000	125				125	
Idaho	Fremont: District 1.	120,000		60			60	
Indiana	Adams	151,550			36.9		36.9	
	Allen	53,840			10.34		10.34	
	Boone	223,260		104.5			105	½ mile of brick road.
	Cass: Districts 1-3.	112,425		12	15	8	35	
	Daviess	90,000		27	3		30	
	Delaware	100,000		20	10		30	
	Gibson	77,300			20		20	
	Hancock	273,500		76.5	.5		77	Bridge bonds, $25,000.
	Henry	44,269		21.5		5	26.5	
	Jay	50,370		6.5	9		15.5	
	Martin	189,881		84.54			84.54	
	Miami	636,656		204.38	9.65		214.03	
	Morgan	341,200		273	75		348.75	¾ mile of brick road.
	Union	60,000		14	6		20	
	Vanderburg	266,196			60		60	
Kansas	Johnson	61,269			13		13	
Kentucky	Lewis	6,200		5			5	
	Ohio	30,000			10		10	
Louisiana	Assumption	86,000		46			46	
	De Soto	60,000	71				71	
	East Baton Rouge.	22,000		15			15	
	Iberville: Districts 1, 5, and 6.	14,329		10.5			10.5	
Maryland	Cecil	100,000			3	14	17	
	Prince Georges	16,000		10			10	
Michigan	Alpena	100,000		40			40	
	Baraga	40,000	20	10			30	
	Berrien	500,000			100		100	
	Genesee	700,000		141	14		155	
	Mackinac	100,000		35			35	
	Mason	100,000		32	3		35	
	Midland	56,000		10	5		15	
	Ontonagon	38,000		6	6		12	
	Wayne	2,000,000					83.5	Includes 80 miles of concrete; rest not specified.
	Wexford	50,000		6	4		10	
Minnesota	Lake	20,000	20				20	
	St. Louis	300,000		175			175	
Mississippi	Jackson	160,000	75				125	25 miles of clay and 25 miles of shell.
	Jasper	25,000	40				40	
	Lauderdale	350,000	32.25		51.75		84	
	Neshoba	100,000			28		28	
	Prentiss: Beat 1.	40,000		25			25	
	Yalobusha	62,000	150				150	
	Beats 2 and 4.	48,000	110				110	
Missouri	Callaway	100,000		16	12		28	
	Lafayette	125,000			14		14	
	Lawrence: Mount Vernon	50,000			12		12	
	Pettis	200,000		15	45		60	
Montana	Lewis and Clark	105,000		20			20	
	Lincoln	125,000		40			40	
Nevada	Churchill	23,000	15				15	
	Ormsby	40,000	7		7		14	
New Jersey	Atlantic	307,000		6			19	13 miles of concrete road.
	Cumberland	43,000		20.36			20.36	
	Essex	1,140,505			158		158	
	Morris	400,000			85		85	
	Sussex	154,100			26		26	
New Mexico	Dona Ana	100,000		40			40	

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds*—Continued.

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Mac-adam.	Bitu-minous mac-adam.	Total.	
New York	Franklin	$500,000					124	Gravel and mac-adam.
North Carolina.	Alamance	200,000			45		45	
	Cabarrus	145,000		15	12	6	33	Also 10 steel bridges.
	Cumberland	40,000	50				50	
	Edgecombe: Districts 1–5, 8–11.	200,000	450				450	
	Gaston	300,000	10		90		100	
	Guilford	300,000		15	105		120	
	Haywood	60,000	1	2	30		33	
	Lee	100,000	8	84			92	
	Vance	218,000		200			200	
Ohio	Fayette	909,000		421	4		425	Of this amount $9,000 was used for bridges.
	Franklin	513,260			32	30	65	3 miles of brick.
	Geauga	20,000					2	2 miles of brick.
	Hancock	408,000		2	100		102	
	Highland	7,850		1.2	1.2		2.4	
	Hocking	50,000		2.5	3		7	1.5 miles of brick.
	Licking	701,000			95		133.5	5 miles of concrete and 33.5 miles of brick.
	Mahoning: District 1.	150,000			7.1		14.3	Glutrin 2.6 miles and brick 4.6 miles.
	Mercer	2,134,600		454	135		590.83	Concrete 1⅝ miles.
	Montgomery	477,000		15	55	1	71	
	Morgan	40,000			3.5		4.75	Brick, 1.25 miles.
	Noble	48,000					6	Concrete, 6 miles.
	Preble	11,160			2		2	
	Trumbull	755,000		10	116		128	Concrete, 2 miles. Bridge, $85,000.
Oregon	Jackson	500,000				52	52	
Pennsylvania	Allegheny	15,900,000			604.78	[1] 134.1	836.36	$550,000 bridge bonds. Concrete .62 mile, brick 74.86 miles, and plank 22 miles.
	Carbon	50,000			10		10	
South Carolina.	Dillon	100,000	70				70	Concrete bridge, $17,500.
Tennessee	Campbell: Districts 1–5.	200,000		32	35		67	
	Dickson	250,000		100			100	
	Hamblen	325,000			100		100	
	Polk	405,000		110	15		125	
Texas	Baylor	100,000	83				83	
	Bell: 2 districts.	200,000		90			90	
	Bexar	1,250,000	11	230			241	
	Bosque: District 7.	40,000		10			10	
	Brown: District 1.	150,000	35	60			95	
	Comal	153,000		50			50	
	Cooke: District 1.	100,000		28			28	
	El Paso	617,000	10	3		55	68	
	Freestone: District 1.	50,000	41				41	
	Gonzales: District 1.	150,000	35	40			75	
	Hall	65,000		15		5	20	
	Hays: District 1.	87,000	6	30	9		45	
	Hill: Precinct 1.	250,000		80			80	
	Jackson	124,500	200				200	
	Jefferson	809,500			100		100	

[1] Includes 68.1 miles of bituminous-gravel road.

TABLE 25.—*Counties, districts, beats, and townships giving complete mileage returns of roads built from proceeds of bonds*—Continued.

State.	Counties, districts, beats, and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.					Remarks.
			Sand-clay.	Gravel.	Macadam.	Bituminous macadam.	Total.	
Texas	Jim Wells	$125,000		100			100	
	Leon: Districts 1, 2, 4, 5, 6.	84,000	77				77	
	McCulloch	118,000	41.5	27.5			69	
	McLennan	150,000		64			64	
	Mitchell: District 1.	30,000	27				27	
	Smith	405,000	300				300	
	Stonewall	50,000	40				40	
	Taylor: District 1.	150,000		35	5		40	
	Waller	25,000	23	2			25	
	Williamson	300,000		150			150	
Virginia	Amherst	215,000		1.5	30.5		32	
	Culpeper: Catalpa.	120,000			30		30	
	Dickenson: Clintwood	54,000	7		7		14	
	Kenady	32,000		16			16	
	Dinwiddie	105,000		125			125	
	Lee	440,000			36		84	Includes 48 miles of graded road.
	Montgomery	30,000			8		8	
	Nelson	35,000			7		7	
	Norfolk	200,000			30		30	Proceeds of issue to build 3 toll roads and 3 toll bridges.
	Orange	175,000			30		30	
	Rappahannock: Wakefield.	30,000			7.5		7.5	
	Rockingham: Plains.	30,000			5		5	Mileage built with proceeds of bond issue and joint county and State funds.
	Spotsylvania	100,000		41.8			41.8	
	Warren: District 2.	60,000		14	1		15	
	Wise	960,000			48.2		131	Includes 82.8 miles earth graded.
West Virginia	Marion: Fairmont	400,000					22	Concrete and brick.
	Mannington	300,000					19	
Wisconsin	Florence	38,000	13.18	1.84	7.78		22.8	
	Vilas	60,000	30				30	
Total		63,932,720	3,006.43	5,030.62	3,497.76	771.16	[1] 13,825.28	

[1] In this total there are included the following:

	Miles.
Bituminous concrete pavement	1
Concrete (exclusive of West Virginia)	152.45
Chert gravel (36 miles of this in course of construction)	41
Brick (exclusive of West Virginia)	256.96
Rock	25
Shell	57
Disintegrated granite surfaced	406
Clay	25
Marl	15
Glutrin	2.6
Plank	22
Graded road	287.8
Road not specified	62.5
Total (exclusive of West Virginia)	1,354.31

TABLE 26.—*Townships and towns* [1] *giving complete mileage returns of roads built from proceeds of bonds.*

State.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				
			Sand-clay.	Gravel.	Mac-adam.	Bitu-minous mac-adam.	Total.
Illinois	Carroll: Wysox	$38,500			15		15
	Lee: Ashton	44,000			12		12
Indiana	Bartholomew:						
	Flat Rock	55,500		18.5			18.5
	Wayne	35,240		17			17
	Clay: Sugar Ridge	545,726		343			343
	Daviess:						
	Reeve	21,000		5			5
	Washington	913,988		295.62			295.62
	Gibson:						
	Center	48,460			13		13
	Johnson	69,600			16		16
	Montgomery	171,620			41		41
	Wabash	21,000		6.5			6.5
	White River	85,830			22		22
	Hamilton:						
	Fallcreek	25,931		20			20
	Washington	65,691		35			35
	White River	86,985		50			50
	Henry: Franklin	14,000		6			6
	Huntington: Jackson	32,425		8	3		11
	Knox: Vincennes	189,360		90			90
	Madison: Fall Creek	6,247		2.5			2.5
	Marshall: Bourbon	28,500			8.5		8.5
	Shelby: Shelby	126,097		33.5			33.5
	Wayne:						
	Franklin and New Garden	7,180		2			2
	Green	12,000			2.5		2.5
Massachusetts	Franklin: Gill	4,500		2.5			2.5
Michigan	Baraga: Covington	18,000		8	2		10
	Berrien: Lincoln	20,000		2.5	3		5.5
	Clare: Redding	3,000		2			2
	Delta:						
	Ford River	3,000			1		1
	Wells	10,000			3.5		3.5
	Gogebic: Marenisco	20,000		8			8
	Lake: Ellworth	6,000		3			3
	Monroe: Bedford	39,000			11		11
	Oceana: Hart	44,250			7.85		7.85
	Osceola: Osceola	25,000	2	3.75			[2] 8
	Schoolcraft: Mueller	6,000	6				6
	Wexford: Henderson	2,000		1			1
Minnesota	Cook:						
	Colvill	12,000	15				15
	Maple Hill	15,000	10	2			12
	Itasca:						
	Balsom	20,000	17				17
	Marcell	10,000	5	3			8
	Trout Lake	8,500	10				10
	Roseau: Spruce	5,000	2	2			4
New Jersey	Burlington: Pemberton	10,000		3			3
	Cape May: Lower	5,000		3			3
New York	Chemung: Big Flats	40,645			8		8
	Fulton: Caroga	35,000		.5	4.5	2	7
	Westchester:						
	Scarsdale	147,350			13	7	20
	White Plains	218,000			17	6	23
Ohio	Ashland: Montgomery	98,000		33			33
	Belmont: York	32,000			5		5
	Crawford: Whetstone	250,000		130			130
	Huron:						
	Norwich	46,000			10.75		10.75
	Sherman	40,000			10.25		10.25
	Lorain: Columbia	24,000			6		6
	Mahoning:						
	Poland	115,000					[3] 12.5
	Smith	100,000					[3] 5
	Springfield	90,000			1		[4] 7.33
	Medina: Medina	127,500	41		14		55
	Ottawa: Catawba	20,000	5	4			9

[1] In New York and the New England States the town is synonymous with township.
[2] Concrete road, 2.25 miles.
[3] Brick roads.
[4] Brick road, 6.33 miles.

TABLE 26.—*Townships and towns giving complete mileage returns of roads built from proceeds of bonds*—Continued.

State.	Counties and townships.	Total amount voted to Jan. 1, 1914.	Miles of road built and planned.				
			Sand-clay.	Gravel.	Mac-adam.	Bitu-minous mac-adam.	Total.
Ohio (contd.)	Richland: Weller	$42,000			9		9
	Seneca: Bloom	72,500					[1] 4
	Trumbull: Liberty	100,000					[1] 9
Pennsylvania	Montgomery:						
	Horsham	25,000			6.5		6.5
	Worcester	22,500			5		5
	Warren: South West	20,000	4		2		6
Wisconsin	La Crosse: Onalaska	11,000		10			10
	Sauk: Delton	16,000			4		4
	Total	4,623,625	117	1,153.87	277.35	15	[2] 1,602.30

[1] Brick roads.
[2] In this total there are included 2.25 miles of concrete road and 36.83 miles of brick road; total, 39.08 miles.

TABLE 27.—*Summary of all highway and bridge bonds voted to Jan. 1, 1914.*

State.	State bonds.	County and district bonds.	Township bonds.
Alabama		$5,121,500	
Arizona		808,000	
Arkansas		1,218,315	
California	$18,000,000	15,630,800	
Colorado		134,700	
Connecticut	10,500,000		$576,500
Delaware		1,395,000	
Florida		7,285,000	
Georgia		1,176,000	
Idaho	505,000	1,221,837	
Illinois		420,320	1,618,634
Indiana		18,072,049	35,837,348
Iowa		4,006,314	
Kansas		1,132,375	677,065
Kentucky		1,759,872	
Louisiana		1,932,840	
Maine	2,000,000		78,000
Maryland	9,170,000	750,500	
Massachusetts	14,365,000	813,000	650,473
Michigan		6,382,152	1,926,135
Minnesota		1,388,350	982,805
Mississippi		8,710,872	
Missouri		1,721,500	65,000
Montana		2,239,606	
Nebraska		553,500	246,170
Nevada		175,000	
New Hampshire	1,300,000		40,000
New Jersey		14,386,782	760,600
New Mexico	500,000	246,500	
New York	100,000,000	9,097,923	2,631,165
North Carolina		5,541,273	2,751,300
North Dakota		63,000	
Ohio		35,241,828	5,283,805
Oklahoma		1,440,000	382,288
Oregon		2,150,000	
Pennsylvania		24,839,050	2,333,609
Rhode Island	1,800,000		265,000
South Carolina		410,000	
South Dakota		77,300	3,500
Tennessee		12,674,298	
Texas		24,960,837	
Utah	260,000	440,500	
Vermont			17,321
Virginia		6,632,400	
Washington	190,000	4,408,262	
West Virginia		2,500,000	
Wisconsin		244,000	27,000
Total	158,590,000	229,403,355	57,153,718

APPENDIX C.

TABLE SHOWING COST ELEMENTS OF GRAVEL, MACADAM, AND BITUMINOUS MACADAM ROADS IN MAINE, MASSACHUSETTS, AND NEW JERSEY.

TABLE 28.[1]—*Table showing cost elements of gravel roads for years 1908–1911.*

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 20-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
	1908.								
1	Camden, Me	1,400	26	$1,795.07	69.40	30.62	$3,612	$1,596	$5,208
2	Eastport, Me	1,900	25	1,634.00	50.00	50.00	1,816	1,816	3,632
3	Lisbon, Me	1,800	24	1,703.63	52.53	47.40	2,189	1,975	4,164
4	Presque Isle, Me	1,115	40	1,526.95	46.35	53.50	1,676	1,937	3,614
5	Richmond, Me	775	36	1,066.91	53.90	46.10	2,165	1,858	4,023
6	Rockland, Me	1,250	20	2,382.17	70.30	29.80	7,078	2,987	10,065
7	May's Landing, N. J	73,603	16	37,416.42	34.38	65.62	1,153	2,201	3,355
8	Red Lion, N. J	19,272	12	12,607.26	36.64	63.36	2,108	3,648	5,756
9	Tuckahoe, N. J	17,946	14	25,558.10	54.96	45.04	5,945	4,834	10,780
10	Malaga, N. J	30,307	24	14,040.13	29.46	70.54	600	1,436	2,037
11	Half Acre, N. J	17,793	20	9,961.89	63.89	36.11	1,887	1,068	2,955
12	Farmingdale, N. J	15,840	20	9,232.61	34.78	63.06	1,070	1,940	3,010
13	Eatontown (1st), N. J	17,160	14	32,439.77	14.01	86.12	1,980	12,285	14,265
14	Bayhead, N. J	24,662	24	25,950.75	36.63	63.34	1,695	2,950	4,645
15	Lakehurst, N. J	33,448	24	22,955.98	55.57	44.51	1,677	1,343	3,020
16	Aldine, N. J	7,001	20	11,110.11	56.71	43.28	4,752	3,625	8,377
	1909.								
17	Fairfield, Me	1,819	15	1,165.35	74.11	25.87	3,353	1,166	4,520
18	Falmouth, Me	1,541	21	1,021.12	85.51	14.48	2,842	480	3,323
19	Jay, Me	1,100	15	1,386.71	77.06	22.94	6,833	2,038	8,872
20	Presque Isle, Me	1,100	40	1,500.45	56.27	44.39	2,039	1,600	3,639
21	Rockland, Me	1,600	23	2,366.01	62.00	38.39	4,201	2,603	6,805
22	Sanford, Me	2,425	22	2,773.71	55.22	44.89	3,017	2,454	5,471
23	English Creek, N. J	35,481	20	15,061.12	38.94	61.05	873	1,368	2,241
24	Chestnut Neck, N. J	2,745	27.5	5,697.15	85.44	14.58	6,805	1,161	7,967
25	Schellenger's Landing, N. J	11,066	20	12,258.99	54.37	45.62	3,225	2,670	5,895
26	Goshen, N. J	13,743	20	10,688.66	35.40	64.69	1,451	2,655	4,106
27	Tuckahoe, N. J	22,513	20	24,544.00	53.10	46.91	3,055	2,700	5,755
28	Rio Grande, N. J	15,348	20	14,556.54	34.17	65.83	1,711	3,300	5,011
29	Cranbury, N. J	12,994	20	5,912.88	40.37	59.63	970	1,432	2,402
30	Allentown, N. J	19,668	18	13,439.93	36.78	63.21	1,474	2,533	4,007
31	Lakewood, N. J	11,404	14	8,448.00	36.08	63.92	2,014	3,571	5,586
32	Lakewood, N. J	15,137	24–36	15,048.63	54.32	45.68	1,900	1,600	3,500
33	Barnsboro, N. J	17,476	20	12,589.80	41.15	65.99	1,565	2,510	4,075
34	Alloway, N. J	25,132	20	21,100.29	55.56	44.44	2,462	1,970	4,432
	1910.								
35	Augusta, Me	3,500	21	2,727.64	13.49	46.78	529	1,833	2,362
36	Bridgton, Me	2,500	15	1,657.69	71.04	28.96	3,312	1,366	4,678
37	Camden, Me	1,300	21	1,883.25	21.56	78.48	1,569	5,714	7,283
38	Dexter, Me	712	21	1,239.67	42.37	57.63	3,714	5,038	8,752
39	Eastport, Me	2,375	18	1,128.74	56.61	43.38	1,575	1,208	2,784
40	Fairfield, Me	1,500	22	3,786.74	63.74	36.27	7,545	4,390	11,936
41	Gorham, Me	1,250	23	967.70	31.50	68.48	1,119	2,434	3,553
42	Kennebunk, Me	4,996	21	2,435.71	13.31	87.00	427	2,023	2,450
43	Lisbon, Me	1,800	24	1,053.02	37.65	62.35	970	1,605	2,575
44	Millinocket, Me	1,500	30	1,071.32	29.97	70.30	756	1,760	2,516
45	Milo, Me	1,500	21	1,018.30	36.99	63.01	1,214	2,150	3,364
46	Mount Desert, Me	1,030	22	1,370.47	85.22	14.78	5,456	945	6,401
47	Norway, Me	1,115	23	1,028.61	90.65	9.40	3,836	398	4,234
48	Orono, Me	1,800	25	1,043.20	68.21	31.80	1,670	779	2,449
49	Paris, Me	1,450	25	1,080.00	24.06	75.92	756	2,384	3,140

[1] This table was compiled from the annual reports of the State highway departments of the three States concerned. Geographical names given in New Jersey are sometimes not names of places, but of roads or streets.

TABLE 28.—*Table showing cost elements of gravel roads for years 1908–1911*—Contd.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 20-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
	1910—Continued.								
50	Presque Isle, Me	1,600	21	$1,675.05	41.92	58.10	$2,205	$3,380	$5,586
51	Rockland, Me	2,000	24	2,193.74	88.16	11.84	4,245	570	4,815
52	Sanford, Me	1,900	26	1,860.29	32.15	67.85	1,280	2,700	3,980
53	Scarboro, Me	2,000	21	1,048.13	19.11	80.89	502	2,133	2,636
54	Waterville, Me	1,800	29	1,803.05	24.70	75.26	901	2,743	3,644
55	Yarmouth, Me	1,360	24	1,738.48	42.49	54.66	2,550	3,075	5,625
56	Cologne, N. J	42,646	20	19,575.36	27.38	72.62	664	1,760	2,424
57	Deans, N. J	14,509	20	9,773.00	34.48	65.52	1,227	2,333	3,560
58	Red Bank, N. J	20,201	18	19,735.21	30.24	69.82	1,735	4,005	5,741
59	Farmingdale, N. J	10,032	18	11,427.88	64.89	35.11	4,332	2,344	6,677
60	Lakewood, N. J	13,200	14	7,381.65	43.91	56.09	1,851	2,364	4,215
61	Barnsboro, N. J	17,476	20	8,489.80	61.02	38.98	1,564	999	2,564
	1911.								
62	Allentown, N. J	10,274	18	15,117.98	35.61	64.39	3,082	5,520	8,602
63	Red Bank, N. J	8,184	18	17,262.78	17.54	80.96	2,592	9,994	12,586
64	Lakewood, N. J	18,458	14	8,737.53	60.55	39.52	2,160	1,410	3,570
65	Lakewood, N. J	5,174	14	3,579.96	50.01	49.99	2,610	2,607	5,217
66	Cedar Ave., N. J	13,807	16,18	22,442.25	21.70	78.30	2,190	7,731	9,921
67	Seaside Park, N. J	28,395	24	42,347.32	35.61	64.38	2,337	4,225	6,562
68	Elmerborough, N. J	9,387	18,42	8,048.75	23.58	76.42	710	2,305	3,016
69	Camden, Me	1,000	30	1,588.77	42.10	57.92	2,353	3,233	5,586
70	Dexter, Me	1,400	26	1,105.20	40.43	59.65	1,293	1,911	3,205
71	Eastport, Me	1,844	22	1,175.15	59.47	40.53	1,818	1,238	3,056
72	Fairfield, Me	650	23	1,549.41	60.91	39.09	6,652	4,282	10,934
73	Farmington, Me	1,350	23	1,225.00	52.37	47.61	2,181	1,982	4,163
74	Freeport, Me	900	20	1,440.16	34.24	65.76	2,892	5,550	8,442
75	Gorham, Me	2,050	23	1,220.39	42.33	57.69	1,156	1,575	2,732
76	Kennebunk, Me	4,135	21	2,221.16	37.98	62.00	1,028	1,675	2,703
77	Lisbon, Me	1,350	21	1,880.97	39.65	55.03	2,771	4,228	7,000
78	Millinocket, Me	1,280	30	1,238.44	32.29	67.72	1,100	2,306	3,407
79	Norway, Me	1,300	23	1,096.23	42.74	57.25	1,655	2,213	3,868
80	Old Orchard, Me	1,200	21	1,019.15	43.57	56.43	1,860	2,417	4,278
81	Orono, Me	2,316	25	1,017.03	57.86	42.17	1,648	800	2,448
82	Presque Isle, Me	1,600	24	1,390.28	41.90	58.10	1,599	2,233	3,832
83	Princeton, Me	1,536	24	1,148.25	88.67	11.32	2,910	371	3,281
84	Rockport, Me	630	21	1,031.82	68.09	31.91	5,600	2,628	8,228
85	Sanford, Me	1,800	24	1,565.99	12.93	87.09	495	3,333	3,829
86	Windham, Me	2,000	25	940.69	63.28	35.82	1,284	712	1,996
87	Yarmouth, Me	1,200	24	1,414.13	49.57	50.42	2,533	2,615	5,148
	Total and weighted averages	[1] 143.53	20	4,417.00	41.15	58.85	1,817	2,599	4,416

[1] Miles.

TABLE 29.[1]—*Table showing cost elements of water-bound macadam roads for years 1908–1911.*

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 15-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
	1908.								
1	Augusta, Me.	1,800	21	$2,556.29	44.9	55.1	$2,410	$2,950	$5,360
2	Biddeford, Me.	1,800	27	4,067.68	48.8	51.2	3,240	3,400	6,640
3	Brewer, Me.	1,300	47	2,198.44	26.6	73.4	760	2,080	2,840
4	Calais, Me.	2,100	21	1,787.05	26.9	73.1	860	2,340	3,200
5	Caribou, Me.	670	45	1,646.14	25.5	74.5	1,100	3,220	4,320
6	Farmington, Me.	1,000	16	1,207.99	14.8	85.2	880	5,090	5,970
7	Gardiner, Me.	1,660	21	1,978.10	22.4	77.6	1,000	3,490	4,490
8	Houlton, Me.	2,000	21	2,033.50	21.6	78.4	830	3,000	3,830
9	Jay, Me.	1,000	16	1,140.18	13.8	86.2	780	4,860	5,640
10	Saco, Me.	866	35	1,898.45	19.7	80.3	980	3,970	4,950
11	Sanford, Me.	2,400	16	2,632.04	75.6	24.4	4,100	1,320	5,420
12	Skowhegan, Me.	1,900	15	2,027.85	56.5	43.5	3,180	2,450	5,630
13	South Portland, Me.	640	20	1,356.30	20.4	79.6	1,710	6,670	8,380
14	Riverdale, N. J.	26,240	14	33,437.76	31.3	68.7	2,260	4,950	7,210
15	Westwood, N. J.	6,260	14	8,225.83	20.2	79.8	1,500	5,940	7,440
16	Franklin, N. J.	8,400	14	16,199.90	59.7	40.3	6,520	4,400	10,920
17	Summit, N. J.	9,770	14	17,352.93	41.2	58.8	4,140	5,900	10,040
18	Lumberton, N. J.	2,060	14	31,110.00	5.1	94.9	440	8,110	8,550
19	Westfield, N. J.	16,470	14	32,745.23	19.8	80.2	2,230	9,010	11,240
20	West Fairfield, N. J.	11,160	16	17,494.24	12.5	87.5	970	6,780	7,750
21	Westville, N. J.	7,750	16	11,104.20	25.0	75.0	1,780	5,330	7,110
22	Harrison Street, N. J.	6,860	16	10,549.60	30.5	69.5	2,320	5,280	7,600
23	Watchung, N. J.	4,650	16	17,074.76	63.3	36.7	11,510	6,670	18,180
24	High Street, N. J.	5,240	16	10,817.30	44.3	55.7	4,530	5,690	10,220
25	Whitehouse, N. J.	34,190	14	52,982.30	28.0	72.0	2,460	6,310	8,770
26	Etra, N. J.	6,280	14	9,329.38	18.6	81.4	1,560	6,840	8,400
27	Brunswick, N. J.	19,540	16	34,663.66	22.6	77.4	1,980	6,800	8,780
28	Colonia, N. J.	8,400	14	14,444.61	33.4	66.6	3,250	6,470	9,720
29	Cranbury, N. J.	5,300	14	7,059.80	14.6	85.4	1,100	6,430	7,530
30	Livingston Avenue, N. J.	5,910	16	10,693.87	14.0	86.0	1,250	7,690	8,940
31	Main Street, Woodbridge, N. J.	9,240	14	19,271.27	42.1	57.9	4,970	6,830	11,800
32	State St., Perth Amboy, N. J.	7,180	14	10,995.50	27.9	72.1	2,420	6,250	8,670
33	River Road "A," N. J.	8,760	14	17,157.42	33.1	66.9	3,660	7,410	11,070
34	River Road "B," N. J.	15,620	14	32,805.66	39.1	60.9	4,630	7,220	11,850
35	Jamesburg, N. J.	15,100	14	24,102.39	20.4	79.6	1,840	7,190	9,030
36	Manalapan, N. J.	1,400	14	3,616.45	17.5	82.5	2,560	12,060	14,620
37	Rumson Road, N. J.	4,010	16	9,123.39	19.4	80.6	2,180	9,070	11,250
38	Eatontown (2d), N. J.	17,480	14	25,988.28	21.1	78.9	1,780	6,640	8,420
39	Allentown, N. J.	5,040	18	10,664.37	13.1	86.9	1,220	8,090	9,310
40	Midvale, N. J.	16,530	16	43,422.05	71.9	28.1	9,350	3,660	13,010
41	Macopin, N. J.	9,820	14	20,544.09	66.1	33.9	7,820	4,010	11,830
42	South Bound Brook, N. J.	11,880	14	21,113.73	41.2	58.8	4,140	5,910	10,050
43	Dead River, N. J.	11,190	14	18,589.99	29.5	70.5	2,770	6,620	9,390
44	North Broad Street, N. J.	5,050	16	15,801.63	30.1	69.9	4,670	10,830	15,500
45	Terrill Road, N. J.	5,300	16	8,054.08	28.9	71.1	2,170	5,350	7,520
	1909.								
46	Brewer, Me.	1,575	24	1,486.75	12.7	87.3	390	2,720	3,110
47	Calais, Me.	2,100	21	1,811.65	20.4	79.6	660	2,590	3,250
48	Camden, Me.	750	30	1,712.52	50.9	49.1	3,070	2,960	6,030
49	Caribou, Me.	533	37	1,106.00	13.6	86.4	610	3,840	4,450
50	Dexter, Me.	675	19	1,009.30	55.3	44.7	3,430	2,780	6,210
51	Eden, Me.	1,100	24	3,012.18	50.7	49.3	4,580	4,450	9,030
52	Gardiner, Me.	1,200	21	3,038.32	26.3	73.7	2,510	7,030	9,540
53	Houlton, Me.	1,500	21	2,499.73	50.5	49.5	3,170	3,100	6,270
54	Rumford, Me.	6,831	20	7,364.80	32.5	67.5	1,380	2,880	4,260
55	Saco, Me.	775	35	2,060.80	14.6	85.4	880	5,150	6,030
56	Skowhegan, Me.	1,550	15	2,134.85	48.2	51.8	3,500	3,760	7,260
57	South Portland, Me.	525	25	1,420.34	13.7	86.3	1,190	7,370	8,560
58	Waterville, Me.	1,300	40	2,726.40	8.5	91.5	350	3,800	4,150
59	Yesler Way, N. J.	14,020	14	18,850.72	32.9	67.1	2,500	5,100	7,600
60	Valley Road, N. J.	16,530	14	15,409.85	25.4	74.6	1,340	3,940	5,280
61	Bridge Street, N. J.	700	16	2,374.79	36.5	63.5	6,140	10,720	16,860
62	Whitehouse, N. J.	30,980	14	42,934.46	41.0	59.0	3,210	4,630	7,840
63	North Crosswicks, N. J.	1,160	16	2,354.95	11.0	89.0	1,100	8,930	10,030
64	Cheesequakes Creek, N. J.	10,400	14	33,366.90	57.0	43.0	10,340	7,810	18,150
65	Jamesburg, N. J.	6,970	14	10,782.65	9.9	90.1	860	7,890	8,750

[1] See footnote 1, Table 28, p. 86.

TABLE 29.[1]—*Table showing cost elements of water-bound macadam roads for years 1908–1911*—Continued.

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 15-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
	1909—Continued.								
66	Keyport, N. J.	6,340	16	$16,850.21	53.7	46.3	$7,070	$6,100	$13,170
67	Penn's Grove, N. J.	15,950	16	26,599.42	20.5	79.5	1,690	6,560	8,250
68	Terrill (1), N. J.	620	14	1,014.17	21.8	78.2	2,010	7,200	9,210
69	Green Brook, N. J.	6,120	14	12,469.55	43.8	56.2	5,050	6,470	11,520
70	Washington Valley, N. J.	10,940	14	26,714.22	60.4	39.6	8,510	5,570	14,080
71	Frankford, N. J.	18,240	14	34,747.92	47.7	52.3	5,140	5,640	10,780
72	Morris, N. J.	6,180	16	11,210.09	50.1	49.9	4,500	4,480	8,980
73	New Brunswick, N. J.	3,960	16	10,246.74	46.7	53.3	5,980	6,830	12,810
	1910.								
74	Augusta, Me.	585	21	831.12	4.4	95.6	240	5,110	5,350
75	Bath, Me.	1,680	20	2,370.50	31.5	68.5	1,760	3,830	5,590
76	Biddeford, Me.	1,324	21	2,625.50	18.9	81.1	1,410	6,070	7,480
77	Brewer, Me.	1,500	40	1,996.84	39.9	60.1	1,050	1,590	2,640
78	Calais, Me.	1,400	21	1,625.53	39.9	60.1	1,740	2,630	4,370
79	Caribou, Me.	773	27	2,234.00	44.9	55.1	3,810	4,670	8,480
80	Dover, Me.	455	36	1,222.56	23.8	76.2	1,410	4,500	5,910
81	Fort Fairfield, Me.	832	32	1,487.00	49.7	50.3	2,200	2,220	4,420
82	Freeport, Me.	700	21	1,230.74	33.9	66.1	2,250	4,380	6,630
83	Hallowell, Me.	437	39	1,240.90	17.2	82.8	990	4,770	5,760
84	Houlton, Me.	1,400	22	2,252.00	33.4	66.6	1,930	3,850	5,780
85	Jay, Me.	1,150	21	1,235.56	19.0	81.0	770	3,280	4,050
86	Oldtown, Me.	1,005	21	1,821.93	32.6	67.4	2,230	4,600	6,830
87	Rumford, Me.	4,320	23	6,227.56	25.6	74.4	1,270	3,690	4,960
88	Berwick, Me.	800	21	1,016.94	27.0	73.0	1,300	3,500	4,800
	1911.								
89	Brunswick, Me.	1,300	21	1,836.82	25.7	74.3	1,370	3,950	5,320
90	Caribou, Me.	333	46	1,406.24	30.4	69.6	2,210	5,060	7,270
91	Hallowell, Me.	500	20	1,080.00	19.2	80.8	1,640	6,910	8,550
92	Houlton, Me.	1,700	21	2,667.10	21.5	78.5	1,270	4,640	5,910
93	Oldtown, Me.	800	22	1,829.07	42.9	57.1	3,530	4,700	8,230
94	Rumford, Me.	1,125	23	2,604.47	18.5	81.5	1,480	6,500	7,980
95	Wilton, Me.	1,200	21	1,311.21	28.7	71.3	1,180	2,920	4,100
	1910.								
96	Ringoes, N. J.	21,550	14	36,425.67	31.6	68.4	3,020	6,540	9,560
97	Asbury, N. J.	5,280	14	7,500.00	34.4	65.6	2,770	5,270	8,040
98	Main Street, N. J.	68,800	14	15,810.67	43.2	56.8	5,620	7,380	13,000
99	Frankford, N. J.	18,250	14	34,747.92	47.7	52.3	5,140	5,630	10,770
	1911.								
100	Smalley's Corner, N. J.	16,860	15	22,759.49	24.1	75.9	1,890	5,960	7,850
101	Brunswick, N. J.	5,340	16	10,450.65	15.4	84.6	1,490	8,200	9,690
102	Yardville, N. J.	18,000	14	32,396.84	15.5	84.5	160	860	1,020
103	Greater Cross Roads, N. J.	10,470	14	20,633.71	29.6	70.4	3,300	7,850	11,150
104	Buttzville, N. J.	19,420	14	31,371.99	37.6	62.4	3,430	5,700	9,130
	Total and weighted averages	[2] 137.51	15	8,688.00	36.89	63.11	3,400	5,815	9,215

[1] See footnote 1, Table 28, p. 86.

[2] Miles.

TABLE 30.[1]—*Table showing cost elements of bituminous-macadam roads for 1908–1911*

No.	Location.	Length (feet).	Width (feet).	Total cost of work.	Percentage of cost.		Cost per mile of equivalent 15-foot width.		
					Drainage and grading.	Surfacing.	Drainage and grading.	Surfacing.	Total.
	1908.								
1	Kennebunk, Me.	426	27	$1,597.30	25.3	74.7	$2,780	$8,220	$11,000
2	Waterville, Me.[2]	760	46	3,565.18	11.5	88.5	930	7,150	8,080
	1909.								
3	Camden, N. J.	12,693	14	29,043.42	28.3	71.7	3,660	9,290	12,950
4	Evesham, N. J.[3]	12,838	14	22,649.61	20.8	79.2	2,080	7,910	9,990
5	Hopewell, N. J.[2]	10,720	18	16,121.40	21.0	79.0	1,390	5,230	6,620
6	Trenton, N. J.	13,227	16	24,509.44	20.3	79.7	1,870	7,320	9,190
7	Helmetta, N. J.	14,271	14	21,375.59	11.3	88.7	960	7,510	8,470
8	Plainsboro, N. J.	12,992	14	21,596.57	13.7	86.3	1,290	8,100	9,390
9	Terrill, N. J.	9,982	16	26,404.08	37.2	62.8	4,870	8,230	13,100
10	Stoutsburg, N. J.	10,845	14	19,741.90	22.0	78.0	2,270	8,030	10,300
11	Edgar, N. J.	17,526	16	42,424.74	25.0	75.0	2,990	8,990	11,980
12	Washington Avenue, N. J.	6,125	16	14,230.20	23.4	76.6	2,690	8,810	11,500
13	Walnut Avenue, N. J.	6,313	16	15,868.00	19.7	80.3	2,450	9,990	12,440
	1910.								
14	Belfast, Me.[4]	580	21	1,997.53	43.7	56.3	5,670	7,310	12,980
15	Coffin's Corner, N. J.	11,866	14	25,138.87	14.8	85.2	1,780	10,220	12,000
16	Nicholson, N. J.	6,532	14	13,168.82	14.6	85.4	1,660	9,740	11,400
17	Brown's Corner, N. J.	8,601	14	20,468.00	24.3	75.7	3,270	10,180	13,450
18	Runnymeade, N. J.	8,984	16	19,408.76	30.9	69.1	3,310	7,390	10,700
19	Mountain, N. J.	325	16	561.00	5.0	95.0	430	8,190	8,620
20	River Road, N. J.	6,458	16	13,705.67	13.7	86.3	1,440	9,070	10,510
21	Kingston, N. J.	3,805	14	6,555.88	17.9	82.1	1,740	8,000	9,740
22	Somerset Street, N. J.	2,040	14	4,252.27	45.5	54.5	5,380	6,440	11,820
23	Seventh Street, N. J.	8,700	14	15,213.40	14.4	85.6	1,390	8,290	9,680
24	Morris Plains, N. J.	13,718	14	33,176.53	26.9	73.1	3,680	9,990	13,670
25	Gladstone, N. J.	21,053	14	42,979.47	27.3	72.7	3,130	8,320	11,450
26	Pompton, N. J.	15,516	14	18,930.85	29.2	70.8	2,020	4,890	6,910
27	Union, N. J.	4,164	14	12,251.98	8.1	91.9	1,350	15,290	16,640
28	Warrenville, N. J.	3,600	14	8,310.13	48.8	51.2	6,370	6,690	13,060
29	Frankford, N. J.	17,309	14	25,313.87	37.6	62.4	3,110	5,170	8,280
30	Raritan, N. J.	13,013	16	40,820.75	28.1	71.9	4,360	11,170	15,530
31	Washington Avenue, N. J.	1,300	16	3,272.00	29.4	70.6	3,670	8,810	12,480
32	Beattystown, N. J.	45,341	14	73,580.20	40.1	59.9	3,680	5,500	9,180
	1911.								
33	Brunswick, Me.	640	21	1,461.37	11.2	88.8	970	7,660	8,630
34	East Livermore, Me.	750	26	1,621.35	14.1	85.9	930	5,650	6,580
35	Saco, Me.	580	28	1,925.00	34.4	65.6	3,230	6,160	9,390
36	Chapel, N. J.	4,515	14	12,681.75	28.1	71.9	4,470	11,450	15,920
37	Railroad, N. J.	859	30	4,587.51	9.6	90.4	1,350	12,720	14,070
38	Swedesboro, N. J.	18,115	16	45,633.30	10.4	89.6	1,300	11,170	12,470
39	Rocky Hill, N. J.	4,200	14	8,744.39	35.4	64.6	4,170	7,600	11,770
40	Springfield, N. J.	8,362	16	26,965.52	23.4	76.6	3,730	12,230	15,960
41	Agawam, Mass.[2]	4,720	15	9,726.00	29.3	70.7	3,188	7,692	10,880
42	Chester, Mass.[2]	8,000	15	14,996.00	42.9	57.1	4,246	5,652	9,898
43	Franklin, Mass.[5]	6,360	15	5,547.00	39.4	60.6	1,814	2,791	4,605
44	Holliston, Mass.[5]	9,800	15	10,796.00	46.2	53.8	2,687	3,130	5,817
45	Ipswich, Mass.[5]	4,860	15	5,683.00	34.2	65.8	2,112	4,062	6,174
46	Lakeville, Mass.[2]	10,250	15	14,492.00	39.0	61.0	2,911	4,554	7,465
47	Lanesborough, Mass.[2]	9,070	15	13,080.00	46.7	53.3	3,556	4,059	7,615
48	Milford, Mass.[2]	6,210	15	11,804.00	50.7	49.3	5,089	4,948	10,037
49	Plainville, Mass.	2,570	15	5,053.00	37.5	62.5	3,893	6,489	10,382
50	Seekonk, Mass.[2]	7,920	15	5,552.00	16.6	83.4	615	3,088	3,703
51	Tyngsborough, Mass.	4,250	15	8,301.00	30.5	69.5	3,145	7,167	10,312
52	Wilmington, Mass.	5,790	15	10,570.00	20.2	79.8	1,947	7,692	9,639
53	....do	7,450	15	11,517.00	24.9	75.1	2,032	6,130	8,162
	Total and weighted averages	[6] 84.63	15	10,267.00	26.85	73.15	2,765	7,533	10,298

[1] See footnote 1, Table 28, p. 86.
[2] Bituminous surface coat.
[3] Bituminous pavement on 2,022 square yards.
[4] Bituminous-macadam surface 62 per cent.
[5] Five inches of gravel and a bituminous surface coat.
[6] Miles.

APPENDIX D.

THEORY OF INTEREST APPLIED TO HIGHWAY-BOND CALCULATIONS, WITH SINKING FUND, ANNUITY, AND INTEREST TABLES FOR 60 INTERVALS AND 14 RATES OF INTEREST.

TABLE OF CONTENTS.

APPENDIX D.

THEORY OF INTEREST APPLIED TO BOND CALCULATIONS.

Introduction.—This appendix presents briefly the application of the theory of compound interest to highway bonds. There are six important quantities in terms of which the solution of most problems can be expressed. If i is the rate of interest and n the term of years, these quantities are:

The accumulation of 1 at the end of n years, r^n;

The accumulation of an annuity of 1 per annum at the end of n years, $s_{\overline{n}|}$;

The annual sinking fund which will accumulate to 1 at the end of n years, $1/s_{\overline{n}|}$;

The present value of 1 due in n years, v^n;

The present value of an annuity of 1 per annum for n years, $a_{\overline{n}|}$; and

The annuity for n years which 1 will purchase, or the annuity necessary to discharge a debt of 1 in n years with interest, $1/a_{\overline{n}|}$.

The first three are accumulative functions and the last three are discount or present value functions.

The mathematical formulas for these six quantities are:

$$r^n = (1+i)^n \qquad s_{\overline{n}|} = \frac{(1+i)^n - 1}{i} \qquad \frac{1}{s_{\overline{n}|}} = \frac{i}{(1+i)^n - 1}$$

$$v^n = (1+i)^{-n} \qquad a_{\overline{n}|} = \frac{1-(1+i)^{-n}}{i} \qquad \frac{1}{a_{\overline{n}|}} = \frac{i}{1-(1+i)^{-n}}$$

The values of most of these functions are given more or less completely in published tables of interest.[1]

Definitions.—*Interest* may be defined as the consideration for the use of capital. The capital is called the *principal.*

The *rate* at which a given principal is earning interest requires the adoption of some interval as the unit of time, and this is usually the *year.*

It is clear that interest when received may be added to the principal and so in turn earn interest. This process, called *compounding,* takes place at the end of *stated intervals,* as every three months, six months, or year.

[1] At the end of this appendix, pages 116 to 127, are short tables to seven places for 60 intervals and 14 interest rates.

Mathematical rates.—The *effective rate of interest* is the interest earned by one unit of principal (one dollar) in one unit of time (one year) when interest *is compounded* at the end of each *stated interval.*

The *nominal rate of interest* is the total interest earned by one unit of principal (one dollar) in one unit of time (one year) when interest *is not compounded* at the end of each *stated interval.*

It follows that the nominal and effective rates of interest coincide only when the *stated interval* is the unit of time (one year).

Commercial rate.—In commercial transactions the rate of interest is usually quoted as a rate *per cent,* or per hundred units of principal, instead of a rate *per unit* of principal, as in the above definitions. To find the mathematical rate as above defined, divide the commercial rate by 100. For example, the mathematical rate corresponding to the commercial rate 6 per cent is 6/100, or .06. The mathematical rate is used in the following formulas.

Relation between effective and nominal rates of interest.—In any transaction there is an effective rate of interest i and a corresponding nominal rate of interest j. This relation can be expressed by an algebraic formula which involves the number of *stated intervals,* m, in one year. At the nominal rate j, during each stated interval $1/m$th of a year in length, one unit of principal would earn j/m in interest which, added to the unit, gives an amount $1+j/m$. If the principal 1 accumulates in the first interval to $1+j/m$, it follows by proportion that the principal $1+j/m$ would accumulate in the second interval to $(1+j/m)^2$. In like manner, at the end of the mth interval, the accumulation would be $(1+j/m)^m$. The total interest earned in the m intervals, or one year, is the difference between the accumulation and the original unit of principal, which by definition is the *effective rate* of interest i. Hence the fundamental formula:

$$\boldsymbol{i=(1+j/m)^m-1} \tag{1}$$

or

$$\boldsymbol{1+i=(1+j/m)^m.} \tag{2}$$

Solving for j, there results

$$\boldsymbol{j=m[(1+i)^{1/m}-1].} \tag{3}$$

The number of times, m, that interest is added, or converted into principal each year, is the *frequency of conversion.* A nominal rate of interest, convertible m times a year, is indicated by the symbol $j_{(m)}$.

Example 1.—The nominal rate of interest j on deposits is 3% and interest is added to the principal every six months; to find the effective rate i.

Here $j=.03$ and $m=2$. From formula (1) there results

$$i=(1+.03/2)^2-1=(1.015)^2-1=.030225.$$

The effective rate 3.0225% is thus slightly higher than the corresponding nominal rate convertible twice per annum.

Example 2.—The effective rate of interest is 6%; to find the corresponding nominal rate when interest is convertible semiannually.

Here i and m are given to find j; hence from formula (3) there results

$$j=2[(1+.06)^{\frac{1}{2}}-1]=2(1.06)^{\frac{1}{2}}-2=2.059126-2=.059126.$$

It is necessary to extract the square root of 1.06. The final result shows that $j=5.9126\%$, and again the nominal rate is smaller than the corresponding effective rate.

Amount of* 1 *in n years at compound interest.—Let the effective rate of interest be i. At the end of the first year the accumulation is $1+i$. During the second year this principal $1+i$ will be increased in the ratio of 1 to $1+i$, and will therefore amount at the end of the second year to $(1+i)(1+i)$, or $(1+i)^2$. In this way at the end of n years the amount is $(1+i)^n$.

Let P be the principal and S the amount of P at the end of n years at compound interest at the effective rate i. Since 1 amounts to $(1+i)^n$ in n years, P would amount to $P(1+i)^n$. There results, therefore, the formula

$$S=P(1+i)^n. \tag{4}$$

Hence

$$P=S/(1+i)^n=Sv^n, \tag{5}$$

where

$$v=1/(1+i). \tag{6}$$

If in the above formulas $1+i$ is replaced by $(1+j/m)^m$, to which it is equivalent according to formula (2), it follows that

$$S=P(1+j/m)^{mn}, \tag{7}$$

and where

$$P=S/(1+j/m)^{mn}=Sv^{mn}, \tag{8}$$

$$v=1/(1+j/m). \tag{9}$$

These formulas express the relation between P and S in terms of the nominal rate j and the frequency of conversion m. The values to seven places of decimals of $(1+i)^n$ and v^n for various rates of interest and for 60 intervals or years are given in Tables 31 and 34.

Example 3.—To find the amount of $12,375 at 3% compound interest in 30 years. By formula (4)

$$S=(1+.03)^{30}\times\$12,375=2.4272625\times\$12,375=\$30,037.37.$$

The value of $(1.03)^{30}$ was taken from Table 31.

Example 4.—$12,375 is placed in a bank; to find the amount in 30 years if interest is 3% and is compounded semiannually.

The nominal rate of 3%, convertible twice a year, requires formula (7) with $j=.03$ and $m=2$. Substituting, the result is:

$$S=(1+.03/2)^{2\times30}\times\$12,375=(1.015)^{60}\times\$12,375=2.4432198\times\$12,375=\$30,234.85.$$

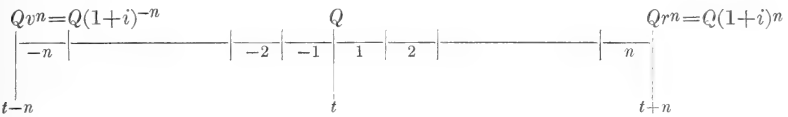
The discount factor.—Because of the power of money to earn interest the value of money depends upon the time to which it is referred. Then in order to compare sums of money due at different times, they must be referred to the *same point in time.*

Formula (5) gives the principal P which will accumulate at the effective rate i in n years to the amount S. If $S=1$ and $n=1$, the formula gives the present value of 1 due in one year. This is usually denoted by the symbol v, so that

$$v=1/(1+i)=(1+i)^{-1}.$$

Similarly $v^2=1/(1+i)^2=(1+i)^{-2}$ is the present value of 1 due in two years, and $v^n=1/(1+i)^n=(1+i)^{-n}$ is the present value of 1 due in n years.

The symbol v is often called the discount factor, and if it is desired to find the value of money *n years before the point in time under consideration,* it is necessary only to multiply the quantity by v^n. The factor $1+i$, which is frequently denoted by r, is accumulative in character, and formula (4) shows that, to find the value of a quantity of money Q, *n years after the point in time under consideration,* it is necessary merely to multiply the quantity by $(1+i)^n$.



More generally, *when i is the effective rate per interval,* the value of Q, at a time n intervals after the point t, is $Q(1+i)^n=Qr^n$, and its value n intervals before point t is $Q(1+i)^{-n}=Qv^n$.

Annuities-certain.—An *annuity* is a series of payments made at *equal intervals* during the continuance of a given *status.*

The *status,* or condition of payment of the annuity, may take a variety of forms. If the status is a fixed term of years, the annuity is an *annuity-certain.* Thus payments of one hundred dollars a year for ten years constitute an annuity-certain. The sum of the payments on an annuity in one year, when the payments are of the same amount, is the *annual rent.*

Payments of twenty-five dollars are made at the end of every month for ten years. This is an annuity-certain with an annual rent of three hundred dollars.

When payments are made at the *end* of each interval, the annuity-certain is said to be *immediate*; when payments are made at the *beginning* of each interval, the annuity-certain is said to be *due.*

Amount of an immediate annuity-certain.—The value of an annuity at the end of its term is called the *amount.* The amount of an immediate annuity-certain for n years with an annual rent 1,

payable at the end of each year, is designated by the symbol $s_{\overline{n}|}$. To find $s_{\overline{n}|}$ each annual payment must be accumulated, at the effective rate of interest i, to the end of the term of the annuity. The first payment of 1 accumulates in $n-1$ years to $(1+i)^{n-1}$; the second payment of 1, in $n-2$ years, to $(1+i)^{n-2}$; etc. . . . . ; the $(n-1)$th payment of 1, in 1 year, to $(1+i)$; and the nth payment at the end of the term is 1. Adding the separate amounts in reverse order, there results

$$s_{\overline{n}|}=1+(1+i)+(1+i)^2+\ldots\ldots\ldots\ldots\ldots+(1+i)^{n-1}.$$

The sum of this geometric series is

$$s_{\overline{n}|}=\frac{(1+i)^n-1}{i}. \tag{10}$$

Values of this quantity are given for various rates of interest and terms in Table 32.

Example 5.—To find the accumulation in 47 years of an annual sinking fund of 1% of $1,000,000, if the fund is credited annually with 3% compound interest.

This is an application of formula (10) where $n=47$ and $i=.03$; since $s_{\overline{47}|}=100.3965009$ the accumulation will be

$$100.3965009\times\$10,000=\$1,003,965.01.$$

The same principles may be applied to find the amount of an annuity for n years with annual rent 1 payable in p equal installments during each year. The amount of such an annuity is designated by the symbol $s^{(p)}_{\overline{n}|}$, and its value is represented by the following formula:

$$s^{(p)}_{\overline{n}|}=\frac{(1+i)^n-1}{p[(1+i)^{1/p}-1]}. \tag{11}$$

If $1+i$ is replaced by $(1+j/m)^m$ in accordance with formula (2), the amount of the annuity is then expressed in terms of the nominal rate of interest j with frequency of conversion m, thus:

$$s_{\overline{n}|}=\frac{(1+j/m)^{mn}-1}{(1+j/m)^m-1}, \tag{12}$$

$$s^{(p)}_{\overline{n}|}=\frac{(1+j/m)^{mn}-1}{p[(1+j/m)^{m/p}-1]}. \tag{13}$$

Example 6.—What will be the accumulation in 47 years of an annual sinking fund of 1% of $1,000,000, paid in semiannually, if the fund is credited as received with 3% interest compounded annually?

This is an application of formula (11) where $n=47$, $p=2$, $i=.03$, hence

$$s^{(2)}_{\overline{47}|}=\frac{(1+.03)^{47}-1}{2\,[(1+.03)^{\frac{1}{2}}-1]}=\frac{3.0118950}{.0297783}=101.143954$$

and the accumulation will be $101.143954\times\$10,000=\$1,011,439.54$.

The special case where interest is converted with the same frequency as the payment of annuity installments, or when $m=p$, deserves particular mention. Formula (13) then reduces to

$$s^{(p)}_{\overline{n}|} = \frac{1}{p} \cdot \frac{(1+j/p)^{np}-1}{j/p} = \frac{1}{p} \cdot s_{\overline{np}|}, \qquad (14)$$

where $s_{\overline{np}|}$ is to be taken at the effective rate j/p.

Example 7.—What will be the accumulation in 47 years of an annual sinking fund of 1% of $1,000,000, paid in semiannually, if the fund is credited with a nominal rate of 3% convertible twice a year?

This is an application of formula (14) where $n=47$, $p=2$, and $s_{\overline{94}|}$ is taken at $1\frac{1}{2}\%$; hence

$$\tfrac{1}{2}\, s_{\overline{94}|} \times \$10{,}000 = \$1{,}017{,}764.25.^{1}$$

Sinking fund which will amount to 1.—An annuity with annual rent of 1 will amount in n years to $s_{\overline{n}|}$; it follows that an annuity with annual rent of $1/s_{\overline{n}|}$ will amount in n years to 1. The quantity $1/s_{\overline{n}|}$ is the *sinking fund* which will accumulate to 1 in n years.

Values for this important function

$$\frac{1}{s_{\overline{n}|}} = \frac{i}{(1+i)^n-1} \qquad (15)$$

are given for various rates of interest and for terms ranging from 1 to 60 intervals or years in Table 33.

Example 8.—To find an annual sinking fund, which, credited with 3% compound interest, will accumulate in 50 years to $1,000,000.

Applying formula (15) where $n=50$, and $i=.03$, there results $1/s_{\overline{50}|}=.0088655$. Therefore the required sinking fund is

$$.0088655 \times \$1{,}000{,}000 = \$8{,}865.50.$$

In like manner $1/s^{(p)}_{\overline{n}|}$ is the annual rent of an annuity which, at the nominal rate j convertible m times a year, will accumulate to 1 in n years. The annual rent is payable in p installments during each year; hence each installment is equal to $1/ps^{(p)}_{\overline{n}|}$. The installments may be regarded as the sinking fund, payable at the end of every pth part of a year, which in n years will accumulate to 1. The amount of each payment to the sinking fund is

$$\frac{1}{ps^{(p)}_{\overline{n}|}} = \frac{(1+j/m)^{m/p}-1}{(1+j/m)^{mn}-1}. \qquad (16)$$

When $p=1$ and $m=2$, formula (16) gives the value of the *annual* sinking fund which, improved at compound interest *semiannually*, will accumulate in n years to 1.

The formula simplifies to the following:

$$\frac{(1+j/2)^2-1}{j/2} \cdot \frac{j/2}{(1+j/2)^{2n}-1} = s_{\overline{2}|} \cdot \frac{1}{s_{\overline{2n}|}} \qquad \text{at } j/2\%. \qquad (17)$$

This formula is of considerable practical importance because payments to the sinking fund are usually made annually and the fund

[1] For calculation of $s_{\overline{94}|}$ see Example 22, page 113.

credited with interest semiannually. Table 6, on page 15, was calculated by formula (17).

Example 9.—To find the annual payment which will accumulate in 20 years to $100,000 when interest is 3½ per cent compounded semiannually.

Taking $n=20$ and $j=.035$ and consulting Tables 32 and 33 with 1¾ per cent interest for values of $s_{\overline{2}|}$ and $1/s_{\overline{40}|}$, respectively, there results:

$$s_{\overline{2}|} \cdot \frac{1}{s_{\overline{40}|}} = 2.0175 \times .0174721 = .0352500.$$

Hence the annual payment to sinking fund is

$$.0352500 \times \$100{,}000 = \$3{,}525.00.$$

Example 10.—To find the sinking fund, which set aside semiannually and accumulated as received, with 3% compound interest, will amount in 50 years to $1,000,000.

Here formula (16) is used with $p=2$, $m=1$, $j=.03$, $n=50$, and

$$\frac{1}{2s_{\overline{50}|}^{(2)}} = \frac{(1+.03)^{\frac{1}{2}}-1}{(1+.03)^{50}-1} = .00439999.$$

The required sinking fund is therefore

$$.00439999 \times \$1{,}000{,}000 = \$4{,}399.99.$$

In the special case when the frequency of conversion coincides with the number of payments per annum, or $m=p$, the amount of *each payment* to the sinking fund is

$$\frac{1}{p s_{n|}^{(p)}} = \frac{j/p}{(1+j/p)^{np}-1} = \frac{1}{s_{\overline{np}|}}, \tag{18}$$

where $s_{\overline{np}|}$ is to be taken at rate j/p.

Example 11.—To find a sinking fund which, set aside semiannually and credited with a nominal rate of 3% convertible twice a year, will accumulate in 30 years to $1,000,000.

Here apply formula (18) by substituting $p=2$, $j=.03$, and $n=30$; this gives

$$\frac{1}{2s_{\overline{30}|}^{(2)}} = \frac{1}{s_{\overline{60}|}} = .0103934,$$

where $1/s_{\overline{60}|}$ is taken at 1½%. Then the sinking fund which would accumulate to $1,000,000 is

$$.0103934 \times \$1{,}000{,}000 = \$10{,}393.40.$$

Four important cases of sinking funds are illustrated in the preceding examples. They arise from the fact that payments to a sinking fund may be annual or semiannual and interest on a sinking fund annual or semiannual. Formula (16) covers all of them when p and m are properly chosen. The following schedule illustrates this fact:

Case.	p	Sinking-fund payments.	m	Interest on sinking fund.	Illustrated in example.
1	1	Annual	1	Annual	8
2	1	Annual	2	Semiannual	9
3	2	Semiannual	1	Annual	10
4	2	Semiannual	2	Semiannual	11

In most cases in the illustrative tables in the body of this bulletin, for simplicity of presentation, annual payments and annual interest are assumed, whereas in practice usually annual payments and semi-annual interest are employed.

Present value of an immediate annuity-certain.—The present value of an immediate annuity-certain for n years, with annual rent 1 payable at the end of each year, is designated by the symbol $a_{\overline{n}|}$. It is equal to the sum of the present values of 1, due at the succeeding yearly intervals. By formula (5) the present value of 1, due at the end of one year at the effective rate of interest i, is $v=1/(1+i)$; at the end of two years, $v^2=1/(1+i)^2$, etc. . . . . ; at the end of n years, $v^n=1/(1+i)^n$. Hence

$$a_{\overline{n}|}=v+v^2+\ldots\ldots\ldots+v^n$$
$$=\frac{1}{1+i}+\frac{1}{(1+i)^2}+\ldots\ldots\ldots+\frac{1}{(1+i)^n}.$$

The sum of this geometric series is

$$\boldsymbol{a_{\overline{n}|}=\frac{1-v^n}{i}=\frac{1-(1+i)^{-n}}{i}} \qquad (19)$$

and its values are given in Table 35.

Example 12.—To find the present value at 3% of an annual payment of $56,325 at the end of each year for thirty years.

Referring to Table 35, it is seen that $a_{\overline{30}|}$ at 3% is 19.6004413, and therefore the equired present value is

$$19.6004413\times\$56,325=\$1,103,994.86.$$

While the above demonstration relates to an annuity of 1 per annum, payable at the end of each year, the same principles apply to finding the present value of an annuity of 1 per annum, payable in p installments during each year. The present value of such an annuity is designated by the symbol $a^{(p)}_{\overline{n}|}$, and its value is represented by the following formula:

$$\boldsymbol{a^{(p)}_{\overline{n}|}=\frac{1-v^n}{p[(1+i)^{1/p}-1]}=\frac{1-(1+i)^{-n}}{p[(1+i)^{1/p}-1]}.} \qquad (20)$$

In formulas (19) and (20) the values of the annuities are expressed in terms of the effective rate i. If $(1+i)$ is replaced by $(1+j/m)^m$ in accordance with formula (2), there result the present values of the same annuities expressed as follows in terms of the nominal rate of interest j, with frequency of conversion m:

$$\boldsymbol{a_{\overline{n}|}=\frac{1-(1+j/m)^{-mn}}{(1+j/m)^m-1},} \qquad (21)$$

and

$$\boldsymbol{a^{(p)}_{\overline{n}|}=\frac{1-(1+j/m)^{-mn}}{p[(1+j/m)^{m/p}-1]}.} \qquad (22)$$

Fundamental relations between the present value and the amount of an annuity.—Since $a_{\overline{n}|}$ and $s_{\overline{n}|}$ are the values of the same annuity upon two dates differing by n years, it follows by the principle of reduction of values from one date to another, explained on page 95, that

$$a_{\overline{n}|} = v^n s_{\overline{n}|},$$
$$s_{\overline{n}|} = (1+i)^n a_{\overline{n}|},$$

and in like manner that

$$a^{(p)}_{\overline{n}|} = v^n s^{(p)}_{\overline{n}|},$$
$$s^{(p)}_{\overline{n}|} = (1+i)^n a^{(p)}_{\overline{n}|}.$$

As tables are not published giving the values of $a^{(p)}_{\overline{n}|}$ and $s^{(p)}_{\overline{n}|}$, when p is different from 1, it is desirable for purposes of computation to express a relation between these functions and the tabulated functions $a_{\overline{n}|}$ and $s_{\overline{n}|}$. This can easily be done by accumulating to the end of each year the p payments of $1/p$ which in $a^{(p)}_{\overline{n}|}$ and $s^{(p)}_{\overline{n}|}$ are distributed at equal intervals through the year. By formula (11) this accumulation to the end of each year will be equal to

$$s^{(p)}_{\overline{1}|} = \frac{i}{p[(1+i)^{1/p}-1]} = \frac{i}{j_{(p)}}.$$

This converts the annuity into one with annual rent $s^{(p)}_{\overline{1}|}$ payable at the end of each year for n years. Therefore

$$\boldsymbol{a^{(p)}_{\overline{n}|}} = \boldsymbol{s^{(p)}_{\overline{1}|}\, a_{\overline{n}|}}, \tag{23}$$

$$\boldsymbol{s^{(p)}_{\overline{n}|}} = \boldsymbol{s^{(p)}_{\overline{1}|} s_{\overline{n}|}}. \tag{24}$$

The most frequent intervals in practice are semiannual, quarterly, and monthly, and to meet this requirement the values of $s^{(2)}_{\overline{1}|}$, $s^{(4)}_{\overline{1}|}$, and $s^{(12)}_{\overline{1}|}$ are given below for various rates of interest.

Values of $\boldsymbol{s^{(p)}_{\overline{1}|} = i/j_{(p)} = \frac{i}{p[(1+i)^{1/p}-1]}}$

p	1½%	1¾%	2%	2¼%	2½%	2¾%	3%
2	1.00373604	1.00435603	1.00497525	1.00559371	1.00621142	1.00682837	1.00744458
4	1.00560755	1.00653878	1.00746906	1.00839839	1.00932677	1.01025422	1.01118072
12	1.00685652	1.00799571	1.00913389	1.01027107	1.01140725	1.01254243	1.01367662

p	3½%	4%	4½%	5%	5½%	6%	7%
2	1.00867475	1.00990195	1.01112621	1.01234754	1.01356596	1.01478151	1.01720402
4	1.01303094	1.01487744	1.01672026	1.01856942	1.02039495	1.02222688	1.02588002
12	1.01594203	1.01820351	1.02046109	1.02271479	1.02496465	1.02721070	1.03169143

Example 13.—What is the present value of an annuity for 30 years at effective rate 3%, payable in monthly installments of $25?

By formula (23) with $n=30$, $p=12$, $i=.03$,

$$a^{(12)}_{\overline{30}|} = s^{(12)}_{\overline{1}|} \cdot a_{\overline{30}|} = 1.01367662 \times 19.6004413 = 19.86850909.$$

Therefore the present value of a similar annuity of $25 per month, or with annual rent of $300, is

$$19.86850909 \times \$300 = \$5{,}960.55.$$

The annuity which 1 will purchase.—The present value $a_{\overline{n}|}$ of an annuity may be viewed as the principal which, invested at the effective rate of interest i, will provide a payment of 1 at the end of each year and will not be exhausted until the end of the nth year; in other words, $a_{\overline{n}|}$ is just sufficient to purchase an n year annuity of annual rent 1 payable at the end of each year. By proportion it appears that 1 will purchase an n year annuity of annual rent $1/a_{\overline{n}|}$ payable at the end of each year. This quantity may be described as the annuity which 1 will purchase, and its value is

$$\frac{1}{\boldsymbol{a}_{\overline{n}|}} = \frac{\boldsymbol{i}}{1-\boldsymbol{v}^{n}} = \frac{\boldsymbol{i}}{1-(1+\boldsymbol{i})^{-n}}. \tag{25}$$

This function is of great importance in annuity bond calculations, and its values are given for 60 terms and different rates of interest in Table 36, on pages 126 and 127.

Example 14.—To find the uniform annual payment which in 20 years will discharge a loan of $100,000, including both principal and interest, at 5 per cent compounded annually.

In this case $n=20$, $i=.05$; employing formula (25) and referring to Table 36, it follows that a loan of 1 will be discharged, both principal and interest, by an annual payment of

$$\frac{1}{a_{\overline{20}|}} = .0802426;$$

hence the loan of $100,000 will be likewise discharged by an annual payment of

$$.0802426 \times \$100{,}000 = \$8{,}024.26.$$

By similar reasoning it follows that 1 will purchase an immediate annuity-certain with annual rent $1/a^{(p)}_{\overline{n}|}$, payable in p installments each year. The value of each *periodical installment* is

$$\frac{1}{\boldsymbol{p}\boldsymbol{a}^{(p)}_{\overline{n}|}} = \frac{(1+\boldsymbol{j}/\boldsymbol{m})^{m/p}-1}{1-(1+\boldsymbol{j}/\boldsymbol{m})^{-mn}}, \tag{26}$$

where interest is at the nominal rate j with frequency of conversion m. When $m=1$, the nominal rate $j_{(1)}$ becomes the effective rate i. When the conversion of interest occurs with the same frequency as the periodical payment, that is, when $m=p$, formula (26) reduces to the important particular case

$$\frac{1}{\boldsymbol{p}\boldsymbol{a}^{(p)}_{\overline{n}|}} = \frac{\boldsymbol{j}/\boldsymbol{p}}{1-(1+\boldsymbol{j}/\boldsymbol{p})^{-np}} = \frac{1}{\boldsymbol{a}_{\overline{np}|}}, \tag{27}$$

where $a_{\overline{np}|}$ is to be taken at j/p per cent.

Example 15.—To find the half yearly payment at 5% compounded semiannually which will discharge both principal and interest on a loan of $100,000 in three years.

By formula (27) with $n=3$, $p=2$, a loan of 1 will be discharged, both principal and interest, in three years by a semiannual payment of

$$\frac{1}{a_{\overline{6}|}\ (\text{taken at } 2\frac{1}{2}\%)} = .1815500,$$

and the loan of $100,000 will be discharged in like manner by

$$.1815500 \times \$100{,}000 = \$18{,}155.00.$$

Installment annuity loan.—The preceding example shows how the function $1/a_{\overline{n}|}$ may be employed to determine the periodical fixed payment which in n years will discharge both principal and interest on a loan. It is to be noted particularly that the lender receives interest throughout the term of the loan on all *outstanding* principal. The following schedule, based on the above example, illustrates the progress of the loan.

SCHEDULE I.—*Showing repayment of principal and interest on a loan of $100,000 by six equal semiannual payments, each of $18,155; interest 5 per cent, compounded semiannually.*

Year.	Principal outstanding at beginning of interval.	Interest for interval.	Semiannual payment.	Principal repayment for interval.
½	$100,000.00	$2,500.00	$18,155.00	$15,655.00
1	84,345.00	2,108.63	18,155.00	16,046.37
1½	68,298.63	1,707.47	18,155.00	16,447.53
2	51,851.10	1,296.28	18,155.00	16,858.72
2½	34,992.38	874.81	18,155.00	17,280.19
3	17,712.19	442.81	18,155.00	17,712.19
Totals	357,199.30	8,930.00	108,930.00	100,000.00

The initial invested principal of $100,000 earns $2,500 interest during the first half year; the first payment of $18,155.00 takes care of this and there remains a balance of $15,655.00 which goes to reduce the outstanding principal to $84,345.00, beginning with the second half year. This process is repeated until the end of the third year, when the last outstanding principal is retired. When preparing such a schedule, the work can be checked by adding the columns. It is evident from the nature of the calculations that, for example, if the first row were omitted from this schedule, the remaining five would represent the schedule for a loan of $84,345.00 on the same terms as the original loan, except that it would be discharged in two and one-half years by five equal semiannual payments. It must therefore be the present value of the five payments, that is,

$$a_{\overline{5}|} \times \frac{\$100,000}{a_{\overline{6}|}} = \$84,345.00,$$

where the annuities are taken at 2½ per cent. Similarly, by successively employing $a_{\overline{4}|}$, $a_{\overline{3}|}$, $a_{\overline{2}|}$, and $a_{\overline{1}|}$, all at 2½ per cent, as multipliers, the figures in the first column of principal outstanding at the beginning of the interval could be obtained. When these are known, the figures in the second column are obtained by multiplying the corresponding figures in the first column by the interest rate for the interval, .025; in the fourth, by successive subtractions of the figures

in the first; and in the third, by adding those in the second to those in the fourth as a check.

Generalization of the annuity loan.—The preceding discussion can most easily be generalized by considering the loan of $a_{\overline{n}|}$ dollars where both principal and interest at *effective rate i per annum* are discharged by equal annual installments of 1 at the end of each year for n years. The initial principal is $a_{\overline{n}|}$; the interest, $ia_{\overline{n}|} = 1 - v^n$; the annual payment, 1, of which $1-(1-v^n) = v^n$ is applied to repayment of principal. But $a_{\overline{n}|} - v^n = a_{\overline{n-1}|}$; hence the outstanding principal at the beginning of the second year is $a_{\overline{n-1}|}$, as might have been predicted in advance. A repetition of this process leads to the following schedule:

SCHEDULE II.—*Showing repayment of principal and interest at effective rate i per annum on a loan of $a_{\overline{n}|}$ by equal annual payments of 1 at the end of each year for n years.*

Year.	Principal outstanding at beginning of year.	Interest due at end of year.	Annual payment at end of year.	Principal repaid at end of year.
1	$a_{\overline{n}|}$	$1-v^n$	1	v^n
2	$a_{\overline{n-1}|}$	$1-v^{n-1}$	1	v^{n-1}
3	$a_{\overline{n-2}|}$	$1-v^{n-2}$	1	v^{n-2}
⋮	⋮	⋮	⋮	⋮
k	$a_{\overline{n-k+1}|}$	$1-v^{n-k+1}$	1	v^{n-k+1}
⋮	⋮	⋮	⋮	⋮
n	$a_{\overline{1}|}$	$1-v$	1	v
Totals	$(n-a_{\overline{n}|})/i$	$n-a_{\overline{n}|}$	n	$a_{\overline{n}|}$

Since this is a schedule for a loan of $a_{\overline{n}|}$, if each item in it, apart from those in the column headed "year," is divided by $a_{\overline{n}|}$ and multiplied by L, there results the corresponding schedule for a loan of L dollars.

For example, the items on a loan of L dollars for the kth year would be

$$\boldsymbol{L a_{\overline{n-k+1}|}/a_{\overline{n}|}},\quad \boldsymbol{L(1-v^{n-k+1})/a_{\overline{n}|}},\quad \boldsymbol{L/a_{\overline{n}|}},\quad \boldsymbol{Lv^{n-k+1}/a_{\overline{n}|}}. \qquad (28)$$

There are some curious properties revealed by the above schedule, among which the following may be pointed out. The principal repayments on an annuity loan increase in geometrical progression, the factor being $1+i$. The sum of these repayments is $a_{\overline{n}|}$; the sum of the annual payments is n; the total interest is $n-a_{\overline{n}|}$; and the check on the first and second columns shows that

$$i(a_{\overline{1}|}+a_{\overline{2}|}+\ldots\ldots\ldots+a_{\overline{n}|}) = n - a_{\overline{n}|}.$$

It is apparent that most of the items in the schedule can be filled in directly from the $a_{\overline{n}|}$ and v^n tables. Having thus filled in each

number, it would be necessary only to multiply each item by $L/a^{\overline{n}|}$ to obtain the corresponding schedule for a loan of L.

If in the preceding discussion *year* is replaced by *interval*, the schedule may be made to apply to loans repaid by equal installments at the end of each interval.

Relation between annuity which 1 will purchase and sinking fund which will amount to 1.—The important relation

$$\frac{1}{a_{\overline{n}|}} = \frac{1}{s_{\overline{n}|}} + i \tag{29}$$

can easily be verified by substitution of the values of $1/a^{\overline{n}|}$ and $1/s^{\overline{n}|}$ expressed in terms of i, by formulas (25) and (15).

The relation (29) merely expresses the fact that the annual rent, $1/a^{\overline{n}|}$ on the annuity which 1 will purchase, must include, not only the interest i on the unit so invested, but also a sinking fund, $1/s^{\overline{n}|}$, which will accumulate to the invested unit at the end of the term of the annuity.

Application to bond calculations.—An important application of the theory of compound interest and annuities arises in the valuation of bonds. First to determine the value of a bond issue redeemable in one sum on a given date, with interest, or dividends, on the outstanding bonds at rate g, and all computed, or *valued*, so as to yield the purchaser a given effective rate of interest i. Consider an issue of $100,000 highway bonds, denomination $500, dated January 1, 1914, maturing January 1, 1948, interest 5 per cent, payable annually.

The annual interest, or dividends, on these bonds is 5 per cent, and the bonds are redeemed at the end of 34 years. Suppose an intending purchaser desires to pay a price which will yield a net income of 3 per cent on his investment; how much ought he to bid? This is the nature of the general problem. If the purchaser desires to realize 5 per cent on his investment, he must bid $100,000 for the bonds, or $1 for each dollar to be redeemed. If, however, he is content with 3 per cent, more than $100,000 must be paid for the bonds, that is, more than $1 for each dollar to be redeemed. In this case the bonds are said to be bought at a *premium*; if less than $1 is paid for each dollar to be redeemed, the bonds are said to be bought at a *discount*.

In the general case, let C denote the price to be paid on redemption; i, the effective rate of interest employed in the valuation of the bonds, which is the *net income* rate to the purchaser; g, the *ratio* of the dividend per annum to C; n, the number of years after which the bonds are redeemed; K, the present value of C, due n years hence,

at the effective rate of interest i; and A, the present value of, or bid on, the bonds.

In the above illustration C=100,000, and n=34. The dividend or interest per annum is 5,000. Hence g=5,000/100,000=.05.

Returning to the general problem, the value of the bonds, so far as the purchaser or holder is concerned, consists of two parts:

1. *The annual interest, or dividend, to be received.*
2. *The sum to be redeemed at the end of n years.*

Hence, to find the present value, A, of the bonds, the present value of each of these parts must be determined and added together. The interest per unit of the redemption price C is, by definition, g; if the interest on 1 unit is g, the interest on C units is gC. Hence at the end of every year for n years the holder will receive gC units.

It is evident that these interest or dividend payments of gC at the end of every year constitute an immediate annuity-certain of annual rent gC and term of n years. The value of such an annuity with annual rent 1 is $a_{\overline{n}|}$; hence the value of the annuity with annual rent gC is

$$gC\,a_{\overline{n}|},$$

where $a_{\overline{n}|}$ is to be taken at the rate of interest i *to be employed in the valuation* of the bonds, a rate which in general is different from g, the rate of dividend.

By formula (5), the present value of the sum C, to be redeemed in n years, is $v^n C$.

Adding these parts together, the result is

$$A = v^n C + gC a_{\overline{n}|}.$$

Substituting in this relation the value of $a_{\overline{n}|}$ given by formula (19), it follows that

$$A = v^n C + \frac{g}{i}(C - v^n C).$$

Since, by definition, $K = v^n C$, the *bid* is given by

$$\boldsymbol{A = K + \frac{g}{i}(C - K)} \qquad (30)$$

and the *premium* by

$$\boldsymbol{A - C = (C - K)\frac{(g - i)}{i}}. \qquad (31)$$

If in formula (31) the *total sum to be redeemed is regarded as unity*, then $C=1$ and $K=v^n$, the present value of 1 due in n years, and there results

$$A=1+\frac{(1-v^n)}{i}(g-i)=1+(g-i)a_{\overline{n}|}. \tag{32}$$

In this formula $a_{\overline{n}|}$ is taken at i per cent, and gives the bid on a bond where the sum to be redeemed is 1. Denoting the excess of A over 1 by k, which is called the *premium*, formula (32) becomes

$$k=(g-i)a_{\overline{n}|}^{i\%}, \tag{33}$$

where the i per cent over the symbol $a_{\overline{n}|}$ means that the function is to be taken from the i per cent annuity table.

This is the fundamental formula in bond calculations. It admits of a very simple interpretation, for it states that the premium on a bond is equal to the present value of an n year annuity at i per cent whose annual rent is the excess $(g-i)$ of the nominal rate of dividend of the bond over the effective rate of interest i, desired to be realized by the investor.

					Unit redeemed, 1
Unit invested, 1		i	i	i	i
		1 yr.	2 yrs.	$n-1$ yrs.	n yrs.
Premium,	k	$g-i$	$g-i$	$g-i$	$g-i$

The dividend paid each year on each unit of the bond to be redeemed is g, which may be divided into two parts, i and $g-i$. For the first part the investor pays 1 and in return receives interest of i each year and the 1 is redeemed at the end of n years. For the second part the investor pays the premium, $k=(g-i)a_{\overline{n}|}$, and this is repaid, both principal and interest at rate i, in n equal annual installments of $(g-i)$. A portion of each installment goes toward the repayment of the premium k which is eventually reduced to zero. This is called the *amortization* or *writing off of the premium*.

It is thus seen that, if k is positive, the bond is bought at a premium; and if k is negative, it is bought at a discount. Since $a_{\overline{n}|}$ is always positive, it appears from formula (33) that the sign of k will be positive when g is greater than i, or *when the rate of dividend is greater than the rate of interest used in valuation;* conversely, when g is less than i, k is negative.

Example 16.—To find the bid on the highway bond mentioned on page 104, on the hypothesis that the purchaser wishes to realize 3% on his investment.

Consider a dollar (unit) of the loan C=100,000. Here $n=34$, $g=.05$, $i=.03$, and by formula (33),

$$k=(.05-.03)a_{\overline{34}|}^{3\%}=.02\times 21.1318367=.422636734,$$

or the premium is slightly over 42 cents on the dollar. Since for each dollar of the loan the purchaser must pay \$1.422636734, for the whole loan of \$100,000 he must pay

$$1.422636734\times\$100{,}000=\$142{,}263.67.$$

Dividends payable and interest convertible semiannually.—When the net income interest rate desired by the investor is nominal, say $j_{(m)}$, and the dividends per unit of the sum to be redeemed are paid in m equal installments, g/m, during the year, it is evident that it is a case of m times n intervals with g/m as dividend and j/m as the *effective rate of interest per interval*. Hence formula (33) becomes

$$k = \frac{(g-j)}{m} a_{\overline{mn}|}^{j/m\%} . \tag{34}$$

In particular, if the net income is $j_{(2)}$, and the dividend payments are semiannual,

$$k = \frac{(g-j)}{2} a_{\overline{2n}|}^{j/2\%} . \tag{35}$$

This formula provides for the valuation of all bonds, redeemed in one sum at the end of a term of n years and with semiannual dividends. Particular attention is called to the fact that the annuity must be taken for the term $2n$, and at the rate of interest $j/2$.

Example 17.—What is the bid on $100,000 highway 5% bonds maturing at the end of 3 years, interest payable semiannually, to net purchaser a nominal rate of 4% convertible half-yearly?

Here $n=3$, $g=.05$, $j=.04$, $m=2$, and formula (35) gives

$$k = \frac{(.05-.04)}{2} a_{\overline{6}|}^{2\%} = .005 \times 5.6014309 = .0280071545.$$

Hence the premium on $100,000 is $2,800.72, and the corresponding bid is $102,800.72. The progress of this bond loan is illustrated in the following schedule.

SCHEDULE III.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Semiannual dividend of 2½% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
½	$102,800.72	$2,056.01	$2,500.00	$443.99	0.00
1	102,356.73	2,047.13	2,500.00	452.87	0.00
1½	101,903.86	2,038.08	2,500.00	461.92	0.00
2	101,441.94	2,028.84	2,500.00	471.16	0.00
2½	100,970.78	2,019.42	2,500.00	480.58	0.00
3	100,490.20	2,009.80	2,500.00	490.20	$100,000.00
Totals	609,964.23	12,199.28	15,000.00	2,800.72	100,000.00

At the outset the holder has an investment of $102,800.72 upon which, at 2 per cent, at the end of the first half-year, $2,056.01 interest is due; the dividend payment of $2,500.00 then made on the bonds provides for this interest and a balance of $443.99 remains, which is applied to *amortize* or *write off* the premium so that the *book-value*, or invested principal, is reduced to $102,356.73 at the beginning of the second half-year. This process continues for three years until the entire premium of $2,800.72 is written off and the bonds are redeemed by the payment of $100,000. The various columns are added and the checks upon these totals are obvious.

Example 18.—What is the bid on $100,000 highway 3% bonds maturing at the end of 3 years, interest payable semiannually, to net purchaser a nominal rate of 4% convertible half-yearly?

Here $n=3$, $g=.03$, $j=.04$, $m=2$, and formula (35) gives

$$k=\frac{(.03-.04)}{2}a_{\overline{6}|}^{2\%}=-.005\times 5.6014309=-.0280071545.$$

Hence the *discount* on $100,000 is $2,800.72, and the corresponding bid is $97,199.28. The progress of this bond loan is illustrated in the following schedule.

SCHEDULE IV.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Semiannual dividend of 1½% on bonds.	Accumulation of discount at end of half-year.	Redemption payment at end of half-year.
½	$97, 199. 28	$1, 943. 99	$1, 500. 00	$443. 99	0. 00
1	97, 643. 27	1, 952. 87	1, 500. 00	452. 87	0. 00
1½	98, 096. 14	1, 961. 92	1, 500. 00	461. 92	0. 00
2	98, 558. 06	1, 971. 16	1, 500. 00	471. 16	0. 00
2½	99, 029. 22	1, 980. 58	1, 500. 00	480. 58	0. 00
3	99, 509. 80	1, 990. 20	1, 500. 00	490. 20	$100, 000. 00
Totals	590, 035. 77	11, 800. 72	9, 000. 00	2, 800. 72	100, 000. 00

In this case the holder has an initial investment of $97,199.28, and at the end of the first half-year 2 per cent interest, or $1,943.99, is due. The dividend payment of $1,500.00, then made on the bonds, is *not sufficient* to provide for this interest, and the difference of $443.99 is added to the principal and determines the *book value* at the beginning of the second half-year. This is called the *accumulation* or *writing on* of discount. By continuing this process for three years the entire discount of $2,800.72 is written on the initial principal, and the book value, $100,000, is then redeemed. The totals of the several columns may be used to check the numerical work.

Valuation of bonds redeemed in installments.—For the valuation of bonds which are not redeemed in one sum, but in a series of installments, first consider the simpler case where the dividend payments are annual and the rate of interest is the effective rate i.

Let $C_1, C_2, \ldots C_r$, denote the successive installments by which the bonds are to be redeemed;

$n_1, n_2, \ldots n_r$, the respective number of years after which the successive installments become due;

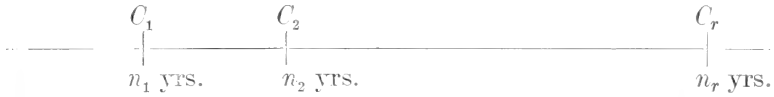
$K_1, K_2, \ldots K_r$, the present values, at the effective rate of interest i, of

C_1 due n_1 years hence,
C_2 due n_2 years hence,
. . . . . .
C_r due n_r years hence;

g, the fixed rate of dividend to be paid on the *outstanding* bonds;

i, the effective rate of interest employed in the valuation of the bonds, which is the *net income* rate to the purchaser;

and $A_1, A_2, \ldots\ldots A_r$, the present values, at the effective rate i, of the separate installments *with their respective dividends.*



Each installment redeemed may be regarded as furnishing a distinct problem under formula (30) so that, in order to value the entire bond issue, it may be treated as made up of r distinct issues and, after finding the value of each one, they may be added together for the value or bid on the total issue.

By formula (30) in the case of a single issue of C_1 at *net income* rate i, dividend rate g, due in n_1 years, the present value, or bid, A_1, is:

$$A_1 = K_1 + (g/i)\ (C_1 - K_1).$$

Similarly,
$$A_2 = K_2 + (g/i)\ (C_2 - K_2),$$
$$\ldots\ldots\ldots\ldots\ldots,$$
$$A_r = K_r + (g/i)\ (C_r - K_r).$$

Adding,

$$(A_1 + A_2 + \ldots\ldots + A_r) = (K_1 + K_2 + \ldots\ldots + K_r) + (g/i)[(C_1 + C_2 + \ldots\ldots + C_r) - (K_1 + K_2 + \ldots\ldots + K_r)].$$

The total sum to be redeemed, $C_1 + C_2 + \ldots\ldots + C_r$, is denoted by C; the total present value of C_1 in n_1 years, C_2 in n_2 years, and so on, which by definition is equal to $K_1 + K_2 + \ldots\ldots + K_r$, by K; and the total value of the issue, $A_1 + A_2 + \ldots\ldots + A_r$, by A; then for the bid there results

$$\boldsymbol{A = K + (g/i)\ (C - K)}, \tag{36}$$

and for the premium,

$$\boldsymbol{A - C = (C - K)\ (g - i)/i}. \tag{37}$$

It thus appears that formulas (30) and (31), which were derived before for the case of a bond issue redeemed in one sum, hold also for the more general issue redeemed in any number of installments.

Installment bonds when total sum to be redeemed is 1.— When 1 is the total sum to be redeemed, that is, when $C = 1$, formula (37) becomes

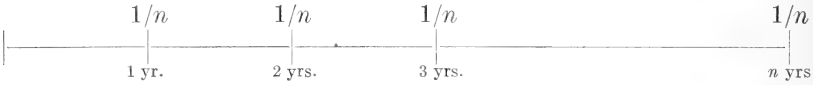
$$\boldsymbol{A - 1 = (1 - K)\ (g - i)/i}, \tag{38}$$

where A is the value of each unit of the sum to be redeemed, and K is the present value of the various parts of the unit at effective rate i due in $n_1, n_2, \ldots n_r$ years. Letting $A-1=k$, formula (38) becomes

$$k=(1-K)\ (g-i)/i. \tag{39}$$

The premium is positive if g is greater than i, and negative, or a discount, if g is less than i; for the first factor $(1-K)$ can not be negative, as K by definition is the *present value* of a series of future payments whose sum is 1, and hence their present discounted value must be less than 1. This shows in all cases that a bond issue must be bought at a *premium*, if it is valued at a *lower* rate i than the rate of dividend g; and at a discount, if it is valued at a higher rate i than the rate of dividend g.

Serial bonds.—To apply the general formula (39) to the case of a bond issue redeemed by n equal annual installments, consider a unit of the total sum to be redeemed. Since this unit is to be redeemed in n equal installments over n years, the annual portion redeemed is $1/n$.



The present value, K, of these n installments is clearly the value of an annuity of annual rent $1/n$; hence

$$K=a_{\overline{n}|}\times 1/n=a_{\overline{n}|}/n.$$

Substituting this value of K in formula (39), the following formula is obtained:

$$k=(1-a_{\overline{n}|}/n)\ (g-i)/i. \tag{40}$$

Example 19.—What is the bid on $100,000 highway 4% serial bonds maturing in 20 equal annual installments, to net the purchaser an effective rate of 3%?

Here $n=20$, $g=.04$, $i=.03$, and $a_{\overline{20}|}^{3\%}=14.8774749$; consequently

$$k=(1-14.8774749/20)(.04-.03)/.03$$
$$=(1-.743873745)\times 1/3=.256126255\times 1/3=.085375418.$$

Hence the bid on $100,000 is

$$1.085375418\times \$100,000=\$108,537.54.$$

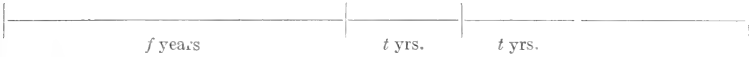
Extension of formulas to case when dividends are payable and interest is convertible m times per annum.—Formula (36) assumes that dividends are payable once a year and that the effective rate of interest is i per annum. Replacing *year* by *interval* and assuming dividends to be paid at the end of each interval and the rate of interest realized by the investor a nominal rate convertible m times a year, formula (36) still applies, if the present value K of the several

installments to be redeemed is calculated at the effective rate j/m per interval, and the dividend per unit of the sum to be redeemed is taken at the rate g/m per interval. The formula is unchanged in form since m cancels out in the ratio g/m to j/m.

General formula for valuation of bonds.—Assume that:

1. The bonds are redeemed in r equal installments.
2. The first redemption of bonds is made at the end of f years.
3. The remaining $r-1$ bond redemptions are made at intervals of t years.
4. The annual rate of dividend is g paid in m equal installments.
5. The bond issue is valued at the nominal rate $j_{(m)}$.

First find the present value, A, of an issue of the above type where $C=1$. The value of a similar total issue of C is then found by multiplying A by C. Since the unit fund is redeemed in r equal installments, each one will be $1/r$.



The total term of the issue is seen to be $f+(r-1)t$ years. As in preceding extension of formulas when dividends are payable and interest is convertible m times per annum, apply formula (36) to each installment of $1/r$ in the unit issue and the formula for the value of k, the premium per unit of the total sum to be redeemed, may readily be obtained. Expressed in terms of annuities, it appears as follows:

$$k=\left[1-\frac{a_{\overline{m(f+tr)}|}-a_{\overline{mf}|}}{ra_{\overline{mt}|}}\right](g-j)/j \qquad \text{at rate } j/m. \qquad (41)$$

The annuity present values in this formula must be computed at the rate of interest j/m. The most common case in practice is where the dividends are paid semiannually. Here $m=2$, and formula (41) becomes:

$$k=\left[1-\frac{a_{\overline{2(f+tr)}|}-a_{\overline{2f}|}}{ra_{\overline{2t}|}}\right](g-j)/j \qquad \text{at rate } j/2. \qquad (42)$$

The last two formulas are very general in their application and have the advantage that when employed in practical computations it is necessary to consult only a table of values of $a_{\overline{n}|}$.

Example 20.—To find the bid on $1,100,000 highway bonds, interest 5% payable semiannually, dated January 1, 1914, maturing $100,000 on January 1, 1922, 1924, 1926, 1928, 1930, 1932, 1934, 1936, 1938, 1940, and 1942, to net the purchaser a nominal rate of 4%, compounded semiannually, on his investment.

Here $f=8$, $t=2$, $r=11$, $g=.05$, $m=2$, and $j_{(2)}=.04$. Accordingly, $m(f+tr)=60$, $mf=16$, and $mt=4$. Substituting in formula (42),

$$k=\left[1-\frac{a_{\overline{60}|}-a_{\overline{16}|}}{11\times a_{\overline{4}|}}\right](.05-.04)/.04 \qquad \text{at } 2\%.$$

Entering Table 35 with 2% for the values of the annuities and numbering the successive steps for convenience of explanation, the calculation may be outlined as follows:

$$a_{\overline{60}|} = 34.7608867 \quad (1)$$
$$a_{\overline{16}|} = 13.5777093 \quad (2)$$
$$a_{\overline{60}|} - a_{\overline{16}|} = 21.1831774 \quad (3)$$
$$(3) \div 11 = 1.9257434 \quad (4)$$
$$a_{\overline{4}|} = 3.8077287$$
$$(4) \div a_{\overline{4}|} = .5057460 \quad (5)$$
$$\text{Complement of (5)} = 1 - (5) = .4942540 \quad (6) = \text{first factor}$$
$$(.05 - .04)/.04 = .25 \quad (7) = \text{second factor}$$
$$k = (6) \times (7) = .1235635.$$

The bid on one dollar is $1+k=1.1235635$; consequently the bid on the whole issue is

$$1.1235635 \times \$1,100,000 = \$1,235,919.85.$$

Example 21.—To find the price of $100,000 highway bonds, interest 5%, semiannual, dated January 1, 1914, maturing $50,000 January 1, 1917, and $50,000 January 1, 1919, to net the investor 4% compounded semiannually.

In this case $f=3$, $r=2$, $t=2$, $m=2$, $g=.05$, $j=.04$, and, substituting as in the preceding example, the required price is found to be $103,646.00. The progress of the loan is indicated in the following schedule.

SCHEDULE V.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2½%.	Semiannual dividend of 2½% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
½	$103,646.00	$2,072.92	$2,500.00	$427.08	0.00
1	103,218.92	2,064.38	2,500.00	435.62	0.00
1½	102,783.30	2,055.67	2,500.00	444.33	0.00
2	102,338.97	2,046.78	2,500.00	453.22	0.00
2½	101,885.75	2,037.72	2,500.00	462.28	0.00
3	101,423.47	2,028.47	2,500.00	471.53	$50,000.00
3½	50,951.94	1,019.04	1,250.00	230.96	0.00
4	50,720.98	1,014.42	1,250.00	235.58	0.00
4½	50,485.40	1,009.71	1,250.00	240.29	0.00
5	50,245.11	1,004.89	1,250.00	245.11	50,000.00
Totals	817,699.84	16,354.00	20,000.00	3,646.00	100,000.00

Extension of term of tables.—It sometimes happens in applying formula (42) that the value of $2(f+tr)$ is greater then the term given in the tables. In example 20 one of the required annuity values was $a_{\overline{60}|}$ but, if the interval between redemptions had been three years instead of two, $2(f+tr)=82$ would have called for the value of an annuity $a_{\overline{82}|}$ beyond the limits of the tables. It is easy, however, to extend these limits by making use of the following obvious relations:

$$v^{m+n} = v^m v^n, \quad (43)$$
$$(1+i)^{m+n} = (1+i)^m (1+i)^n, \quad (44)$$
$$a_{\overline{m+n}|} = [1 - v^m v^n]/i, \quad (45)$$
$$a_{\overline{m+n}|} = a_{\overline{m}|} + v^m a_{\overline{n}|}, \quad (46)$$
$$s_{\overline{m+n}|} = [(1+i)^m (1+i)^n - 1]/i, \quad (47)$$
$$s_{\overline{m+n}|} = (1+i)^n s_{\overline{m}|} + s_{\overline{n}|}. \quad (48)$$

Example 22.—To find $s_{\overline{94}|}$ at $1\frac{1}{2}\%$ when the limit of the tables is 60 years or terms. Applying formula (47) there results

$$s_{\overline{94}|}=s_{\overline{60+34}|}=\frac{(1.015)^{60+34}-1}{.015}=\frac{(1.015)^{60}\times(1.015)^{34}-1}{.015}$$

$$=\frac{2.4432198\times 1.6589964-1}{.015}=203.5528568.$$

By formula (48)

$$s_{\overline{94}|}=s_{\overline{60+34}|}=(1.015)^{34}\cdot s_{\overline{60}|}+s_{\overline{34}|}$$

$$=1.6589964\times 96.2146517+43.9330915=203.5528523.$$

The correct value of $s_{\overline{94}|}$ at $1\frac{1}{2}\%$ to seven places of decimals is 203.5528497; so the above method may be regarded as giving the correct value to about five places of decimals. In most practical cases this will be sufficiently accurate.

Valuation of serial bonds bearing semiannual dividends.—The most common type of serial bond bears semiannual dividends and is redeemed in equal *annual* installments, the first of which is paid at the end of the first year. Formula (42) lends itself directly to the valuation of this bond at a nominal rate of interest j convertible twice a year. In this case $f=t=1$, $r=n$, and

$$k=\left[1-\frac{a_{\overline{2n+2}|}-a_{\overline{2}|}}{na_{\overline{2}|}}\right](g-j)/j \qquad \text{at rate } j/2. \tag{49}$$

Formula (49) requires the use of a table of values of $a_{\overline{n}|}$ only. It can be put in another convenient form for computation involving the use of a table of values of $a_{\overline{n}|}$ and $s_{\overline{n}|}$. For, by formula (46), $a_{\overline{2+2n}|}=a_{\overline{2}|}+v^2a_{\overline{2n}|}$, and, since $v^2/a_{\overline{2}|}=1/(1+i)^2a_{\overline{2}|}=1/s_{\overline{2}|}$, after a simple reduction, there results

$$k=\left[1-\frac{a_{\overline{2n}|}}{ns_{\overline{2}|}}\right](g-j)/j \qquad \text{at rate } j/2. \tag{50}$$

Example 23.—$300,000 highway serial bonds bearing 4% interest payable semiannually, dated January 1, 1914, mature $100,000 January 1, 1915, 1916, and 1917. What price should be paid to realize a net income of 3% compounded semiannually?

Here $n=3$, $g=.04$, $j_{(2)}=.03$, and by formula (49)

$$k=\left[1-\frac{a_{\overline{3}|}-a_{\overline{2}|}}{3a_{\overline{2}|}}\right](.04-.03)/.03 \qquad \text{at } 1\tfrac{1}{2}\%$$

$$=.0575373\times 1/3=.0191791,$$

therefore the price to earn 3% compounded semiannually is

$$1.0191791\times\$300{,}000=\$305{,}753.73.$$

The following schedule illustrates the progress of this loan.

SCHEDULE VI.

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 1½%.	Semiannual dividend of 2% on bonds.	Amortization of premium at end of half-year.	Redemption payment at end of half-year.
½	$305,753.73	$4,586.31	$6,000.00	$1,413.69	0.00
1	304,340.04	4,565.10	6,000.00	1,434.90	$100,000.00
1½	202,905.14	3,043.58	4,000.00	956.42	0.00
2	201,948.72	3,029.23	4,000.00	970.77	100,000.00
2½	100,977.95	1,514.67	2,000.00	485.33	0.00
3	100,492.62	1,507.38	2,000.00	492.62	100,000.00
Totals	1,216,418.20	18,246.27	24,000.00	5,753.73	300,000.00

Annuity bonds.—On pages 101 to 104 the operation of a loan where both principal and interest are discharged by equal installments is fully described. It is evident that bonds may be issued on this basis and retired in accordance with the principal repayments contained in the annuity installments. Since these principal repayments are not exact multiples of the amounts or denominations in which bonds are usually issued, it is necessary to adjust the *exact* schedule so as to meet this requirement. The adjusted schedule gives an issue in which the bonds are retired year by year in increasing amounts. Examples of exact and adjusted schedules appear in the body of this bulletin on pages 16 and 17.

To finance a loan of L by an issue of annuity bonds bearing interest or dividends at rate g per annum.—The annual installment which will retire the bonds in n years and at the same time pay interest at the rate of g per cent on outstanding bonds is

$$L/a_{\overline{n}|} \qquad \text{at rate } g. \tag{51}$$

If the bonds are to bear interest of g per cent per annum, payable in p installments of g/p per cent during the year, then

$$L/a_{\overline{np}|} \qquad \text{at rate } g/p \tag{52}$$

is the periodical payment or annuity installment which will take care of interest on the bonds and retire them in n years.

Example 24.—Adjust Schedule I, page 102, to finance the same loan by an annuity bond issue of $100,000, denomination $100, bearing 5% interest, compounded semiannually, and retired in three years by six equal (nearly) semiannual annuity installments.

Referring to Schedule I on page 102, the adjustments in the last column to even multiples of $100 are easily made; a check on this work is that the adjusted column must foot up to $100,000. When the column of bond redemptions is decided upon, the other columns in the schedule are readily derived.

SCHEDULE VII.

(Schedule I adjusted to bonds of denomination $100.)

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2½%.	Annuity installments at end of half-year.	Amortization of premium at end of half-year.	Amount of bonds retired at end of half-year.
½	$100, 000	$2, 500. 00	$18, 200. 00	0. 00	$15, 700
1	84, 300	2, 107. 50	18, 107. 50	0. 00	16, 000
1½	68, 300	1, 707. 50	18, 107. 50	0. 00	16, 400
2	51, 900	1, 297. 50	18, 197. 50	0. 00	16, 900
2½	35, 000	875. 00	18, 175. 00	0. 00	17, 300
3	17, 700	442. 50	18, 142. 50	0. 00	17, 700
Totals	357, 200	8, 930. 00	108, 930. 00	0. 00	100, 000

Valuation of annuity bonds.—In order to value an issue of this character, so as to yield the purchaser a net income at a rate of interest different from the rate of dividend on the bonds, it will ordinarily be necessary to value separately the several parts of the total issue in accordance with the respective dates on which they are retired. This calculation may frequently be shortened by employing formula (36). Bond tables may also be consulted to advantage. The following example and schedule respectively illustrate the calculation of the bid and progress of the loan.

Example 25.—Determine the bid on the entire issue of annuity bonds in Example 24 so as to yield the investor a net income of 4%, compounded semiannually.

Applying formula (35) successively to the several bond issues in the order in which they are retired with $g=.05$ and $j=.04$, the following premiums are found:

$76. 96
155. 32
236. 48
321. 75
407. 71
495. 73

$1, 693. 95

Accordingly, the bid on the entire issue is $101,693.95. The schedule illustrating the progress of this bond issue follows. It is constructed in the same manner as preceding bond schedules and needs no additional explanation.

SCHEDULE VIII.—*Showing the progress of an annuity bond issue of $100,000, denomination $100, bearing 5 per cent interest, compounded semiannually, and retired in three years by six equal (nearly) semiannual annuity installments. Bought to yield the investor 4 per cent, compounded semiannually.*

Year.	Book value or principal at beginning of half-year.	Semiannual interest of 2%.	Annuity installments at end of half-year.	Amortization of premium at end of half-year.	Amount of bonds retired at end of half-year.
½	$101, 693. 95	$2, 033. 88	$18, 200. 00	$466. 12	$15, 700
1	85, 527. 83	1, 710. 56	18, 107. 50	396. 94	16, 000
1½	69, 130. 89	1, 382. 62	18, 107. 50	324. 88	16, 400
2	52, 406. 01	1, 048. 12	18, 197. 50	249. 38	16, 900
2½	35, 256. 63	705. 13	18, 175. 00	169. 87	17, 300
3	17, 786. 76	355. 74	18, 142. 50	86. 76	17, 700
Totals	361, 802. 07	7, 236. 05	108, 930. 00	1, 693. 95	100, 000

TABLE 31.—*The accumulation of 1 at the end of n years.*

$$r^n=(1+i)^n.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0150000	1.0175000	1.0200000	1.0225000	1.0250000	1.0275000	1.0300000	1
2	1.0302250	1.0353063	1.0404000	1.0455063	1.0506250	1.0557563	1.0609000	2
3	1.0456784	1.0534241	1.0612080	1.0690301	1.0768906	1.0847896	1.0927270	3
4	1.0613636	1.0718590	1.0824322	1.0930833	1.1038129	1.1146213	1.1255088	4
5	1.0772840	1.0906166	1.1040808	1.1176777	1.1314082	1.1452733	1.1592741	5
6	1.0934433	1.1097024	1.1261624	1.1428254	1.1596934	1.1767684	1.1940523	6
7	1.1098449	1.1291222	1.1486857	1.1685390	1.1886858	1.2091295	1.2298739	7
8	1.1264926	1.1488818	1.1716594	1.1948311	1.2184029	1.2423806	1.2667701	8
9	1.1433900	1.1689872	1.1950926	1.2217148	1.2488630	1.2765460	1.3047732	9
10	1.1605408	1.1894445	1.2189944	1.2492034	1.2800845	1.3116510	1.3439164	10
11	1.1779489	1.2102598	1.2433743	1.2773105	1.3120867	1.3477214	1.3842339	11
12	1.1956182	1.2314393	1.2682418	1.3060500	1.3448888	1.3847838	1.4257609	12
13	1.2135524	1.2529895	1.2936066	1.3354361	1.3785110	1.4228653	1.4685337	13
14	1.2317557	1.2749168	1.3194788	1.3654834	1.4129738	1.4619941	1.5125897	14
15	1.2502321	1.2972279	1.3458683	1.3962068	1.4482982	1.5021990	1.5579674	15
16	1.2689856	1.3199294	1.3727857	1.4276215	1.4845056	1.5435094	1.6047064	16
17	1.2880203	1.3430281	1.4002414	1.4597429	1.5216183	1.5859560	1.6528476	17
18	1.3073406	1.3665311	1.4282463	1.4925872	1.5596587	1.6295697	1.7024331	18
19	1.3269508	1.3904454	1.4568112	1.5261704	1.5986502	1.6743829	1.7535061	19
20	1.3468550	1.4147782	1.4859474	1.5605092	1.6386164	1.7204284	1.8061112	20
21	1.3670578	1.4395368	1.5156663	1.5956207	1.6795819	1.7677402	1.8602946	21
22	1.3875637	1.4647287	1.5459797	1.6315221	1.7215714	1.8163531	1.9161034	22
23	1.4083772	1.4903615	1.5768993	1.6682314	1.7646107	1.8663028	1.9735865	23
24	1.4295028	1.5164428	1.6084373	1.7057666	1.8087260	1.9176261	2.0327941	24
25	1.4509454	1.5429805	1.6406060	1.7441463	1.8539441	1.9703608	2.0937779	25
26	1.4727095	1.5699827	1.6734181	1.7833896	1.9002927	2.0245458	2.1565913	26
27	1.4948002	1.5974574	1.7068865	1.8235159	1.9478000	2.0802208	2.2212890	27
28	1.5172222	1.6254129	1.7410242	1.8645450	1.9964950	2.1374268	2.2879277	28
29	1.5399805	1.6538576	1.7758447	1.9064973	2.0464074	2.1962061	2.3565655	29
30	1.5630802	1.6828001	1.8113616	1.9493934	2.0975676	2.2566017	2.4272625	30
31	1.5865264	1.7122491	1.8475888	1.9932548	2.1500068	2.3186583	2.5000804	31
32	1.6103243	1.7422135	1.8845406	2.0381030	2.2037569	2.3824214	2.5750828	32
33	1.6344792	1.7727022	1.9222314	2.0839603	2.2588509	2.4479380	2.6523352	33
34	1.6589964	1.8037245	1.9606760	2.1308495	2.3153221	2.5152563	2.7319053	34
35	1.6838813	1.8352897	1.9998896	2.1787936	2.3732052	2.5844258	2.8138625	35
36	1.7091395	1.8674073	2.0398873	2.2278164	2.4325353	2.6554975	2.8982783	36
37	1.7347766	1.9000869	2.0806851	2.2779423	2.4933487	2.7285237	2.9852267	37
38	1.7607983	1.9333384	2.1222988	2.3291960	2.5556824	2.8035581	3.0747835	38
39	1.7872103	1.9671718	2.1647448	2.3816029	2.6195745	2.8806560	3.1670270	39
40	1.8140184	2.0015973	2.2080397	2.4351890	2.6850638	2.9598740	3.2620378	40
41	1.8412287	2.0366253	2.2522005	2.4899807	2.7521904	3.0412705	3.3598989	41
42	1.8688471	2.0722662	2.2972445	2.5460053	2.8209952	3.1249055	3.4606959	42
43	1.8968798	2.1085309	2.3431894	2.6032904	2.8915201	3.2108404	3.5645168	43
44	1.9253330	2.1454302	2.3900531	2.6618644	2.9638081	3.2991385	3.6714523	44
45	1.9542130	2.1829752	2.4378542	2.7217564	3.0379033	3.3898648	3.7815958	45
46	1.9835262	2.2211773	2.4866113	2.7829959	3.1138509	3.4830861	3.8950437	46
47	2.0132791	2.2600479	2.5363435	2.8456133	3.1916971	3.5788709	4.0118950	47
48	2.0434783	2.2995987	2.5870704	2.9096396	3.2714896	3.6772899	4.1322519	48
49	2.0741305	2.3398417	2.6388118	2.9751065	3.3532768	3.7784154	4.2562194	49
50	2.1052424	2.3807889	2.6915880	3.0420464	3.4371087	3.8823218	4.3839060	50
51	2.1368211	2.4224527	2.7454198	3.1104924	3.5230364	3.9890856	4.5154232	51
52	2.1688734	2.4648457	2.8003282	3.1804785	3.6111124	4.0987855	4.6508859	52
53	2.2014065	2.5079805	2.8563348	3.2520393	3.7013902	4.2115021	4.7904125	53
54	2.2344276	2.5518701	2.9134614	3.3252102	3.7939249	4.3273184	4.9341249	54
55	2.2679440	2.5965279	2.9717307	3.4000274	3.8887730	4.4463196	5.0821486	55
56	2.3019631	2.6419671	3.0311653	3.4765280	3.9859924	4.5685934	5.2346131	56
57	2.3364926	2.6882015	3.0917886	3.5547499	4.0856422	4.6942298	5.3916514	57
58	2.3715400	2.7352450	3.1566244	3.6347318	4.1877832	4.8233211	5.5534010	58
59	2.4071131	2.7831118	3.2166969	3.7165132	4.2924778	4.9559624	5.7200030	59
60	2.4432198	2.8318163	3.2810308	3.8001348	4.3997897	5.0922514	5.8916031	60

TABLE 31.—*The accumulation of 1 at the end of n years*—Continued.

$$r^n=(1+i)^n.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0350000	1.0400000	1.0450000	1.0500000	1.0550000	1.0600000	1.0700000	1
2	1.0712250	1.0816000	1.0920250	1.1025000	1.1130250	1.1236000	1.1449000	2
3	1.1087179	1.1248640	1.1411661	1.1576250	1.1742414	1.1910160	1.2250430	3
4	1.1475230	1.1698586	1.1925186	1.2155063	1.2388247	1.2624770	1.3107960	4
5	1.1876863	1.2166529	1.2461819	1.2762816	1.3069600	1.3382256	1.4025517	5
6	1.2292553	1.2653190	1.3022601	1.3400956	1.3788428	1.4185191	1.5007304	6
7	1.2722793	1.3159318	1.3608618	1.4071004	1.4546792	1.5036303	1.6057815	7
8	1.3168090	1.3685691	1.4221006	1.4774554	1.5346865	1.5938481	1.7181862	8
9	1.3628974	1.4233118	1.4860951	1.5513282	1.6190943	1.6894790	1.8384592	9
10	1.4105988	1.4802443	1.5529694	1.6288946	1.7081445	1.7908477	1.9671514	10
11	1.4599697	1.5394541	1.6228531	1.7103394	1.8020924	1.8982986	2.1048520	11
12	1.5110687	1.6010322	1.6958814	1.7958563	1.9012075	2.0121965	2.2521916	12
13	1.5639561	1.6650735	1.7721961	1.8856491	2.0057739	2.1329283	2.4098450	13
14	1.6186945	1.7316765	1.8519449	1.9799316	2.1160915	2.2609040	2.5785342	14
15	1.6753488	1.8009435	1.9352824	2.0789282	2.2324765	2.3965582	2.7590315	15
16	1.7339860	1.8729813	2.0223702	2.1828746	2.3552627	2.5403517	2.9521638	16
17	1.7946756	1.9473005	2.1133768	2.2920183	2.4848022	2.6927728	3.1588152	17
18	1.8574892	2.0258165	2.2084788	2.4066192	2.6214663	2.8543392	3.3799323	18
19	1.9225013	2.1068492	2.3078603	2.5269502	2.7656469	3.0255995	3.6165275	19
20	1.9897889	2.1911231	2.4117140	2.6532977	2.9177575	3.2071355	3.8696845	20
21	2.0594315	2.2787681	2.5202412	2.7859626	3.0782342	3.3995636	4.1405624	21
22	2.1315116	2.3699188	2.6336520	2.9252607	3.2475370	3.6035374	4.4304017	22
23	2.2061145	2.4647155	2.7521664	3.0715238	3.4261516	3.8197497	4.7405299	23
24	2.2833285	2.5633042	2.8760138	3.2250999	3.6145899	4.0489346	5.0723670	24
25	2.3632450	2.6658363	3.0054345	3.3863549	3.8133924	4.2918707	5.4274326	25
26	2.4459586	2.7724698	3.1406790	3.5556727	4.0231289	4.5493830	5.8073529	26
27	2.5315671	2.8833686	3.2820096	3.7334563	4.2443410	4.8223459	6.2138676	27
28	2.6201720	2.9987033	3.4297000	3.9201291	4.4778431	5.1116867	6.6488384	28
29	2.7118780	3.1186515	3.5840365	4.1161356	4.7241244	5.4183879	7.1142571	29
30	2.8067937	3.2433975	3.7453181	4.3219424	4.9839513	5.7434912	7.6122550	30
31	2.9050315	3.3731334	3.9138575	4.5380395	5.2580686	6.0881006	8.1451129	31
32	3.0067076	3.5080588	4.0899810	4.7649415	5.5472624	6.4533867	8.7152708	32
33	3.1119424	3.6483811	4.2740302	5.0031885	5.8523618	6.8405899	9.3253398	33
34	3.2208603	3.7943163	4.4663615	5.2533480	6.1742417	7.2510253	9.9781135	34
35	3.3335905	3.9460890	4.6673478	5.5160154	6.5138250	7.6860868	10.6765815	35
36	3.4502661	4.1039326	4.8773785	5.7918161	6.8720854	8.1472520	11.4239422	36
37	3.5710254	4.2680899	5.0968605	6.0814069	7.2500501	8.6360871	12.2236181	37
38	3.6960113	4.4388135	5.3262192	6.3854773	7.6488028	9.1542524	13.0792714	38
39	3.8253717	4.6163660	5.5658991	6.7047512	8.0694870	9.7035075	13.9948204	39
40	3.9592597	4.8010206	5.8163645	7.0399887	8.5133088	10.2857179	14.9744578	40
41	4.0978338	4.9930615	6.0781009	7.3919882	8.9815408	10.9028610	16.0226699	41
42	4.2412580	5.1927839	6.3516155	7.7615876	9.4755255	11.5570327	17.1442568	42
43	4.3897020	5.4004953	6.6374382	8.1496669	9.9966794	12.2504546	18.3443548	43
44	4.5433416	5.6165151	6.9361229	8.5571503	10.5464968	12.9854819	19.6284596	44
45	4.7023586	5.8411757	7.2482184	8.9850078	11.1265541	13.7646108	21.0024518	45
46	4.8669411	6.0748227	7.5744196	9.4342582	11.7385146	14.5904875	22.4726234	46
47	5.0372840	6.3178156	7.9152685	9.9059711	12.3841329	15.4659167	24.0457070	47
48	5.2135890	6.5705282	8.2714556	10.4012697	13.0652602	16.3938717	25.7289065	48
49	5.3960646	6.8333494	8.6436711	10.9213331	13.7838495	17.3775040	27.5299300	49
50	5.5849269	7.1066834	9.0326363	11.4673998	14.5419612	18.4201543	29.4570251	50
51	5.7803993	7.3909507	9.4391049	12.0407698	15.3417691	19.5253635	31.5190168	51
52	5.9827133	7.6865887	9.8638646	12.6428083	16.1855664	20.6968853	33.7253180	52
53	6.1921082	7.9940523	10.3077385	13.2749487	17.0757725	21.9386985	36.0861224	53
54	6.4088320	8.3138144	10.7715868	13.9386961	18.0149400	23.2550204	38.6121509	54
55	6.6331411	8.6463669	11.2563082	14.6356309	19.0057617	24.6503216	41.3150015	55
56	6.8653011	8.9922216	11.7628420	15.3674125	20.0510786	26.1293409	44.2070516	56
57	7.1055866	9.3519105	12.2921699	16.1357831	21.1538879	27.6971013	47.3015452	57
58	7.3542822	9.7259869	12.8453176	16.9425722	22.3173518	29.3589274	50.6126534	58
59	7.6116820	10.1150264	13.4233569	17.7897009	23.5448061	31.1204631	54.1555391	59
60	7.8780909	10.5196274	14.0274079	18.6791859	24.8397705	32.9876909	57.9464268	60

TABLE 32.—*The accumulation of an annuity of 1 per annum at the end of n years.*

$$s_{n|} = \frac{(1+i)^n - 1}{i}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	2.0150000	2.0175000	2.0200000	2.0225000	2.0250000	2.0275000	2.0300000	2
3	3.0452250	3.0528063	3.0604000	3.0680063	3.0756250	3.0832563	3.0909000	3
4	4.0909034	4.1062304	4.1216080	4.1370364	4.1525156	4.1680458	4.1836270	4
5	5.1522669	5.1780894	5.2040402	5.2301197	5.2563285	5.2826671	5.3091358	5
6	6.2295509	6.2687060	6.3081210	6.3477974	6.3877367	6.4279404	6.4684099	6
7	7.3229942	7.3784083	7.4342834	7.4906228	7.5474302	7.6047088	7.6624622	7
8	8.4328391	8.5075305	8.5829691	8.6591619	8.7361159	8.8138383	8.8923361	8
9	9.5593317	9.6564122	9.7546284	9.8539930	9.9545188	10.0562188	10.1591061	9
10	10.7027217	10.8253995	10.9497210	11.0757078	11.2033818	11.3327648	11.4638793	10
11	11.8632625	12.0148439	12.1687154	12.3249113	12.4834663	12.6444159	12.8077957	11
12	13.0412114	13.2251037	13.4120897	13.6022218	13.7955530	13.9921373	14.1920296	12
13	14.2368296	14.4565430	14.6803315	14.9082718	15.1404418	15.3769211	15.6177955	13
14	15.4503821	15.7095325	15.9739382	16.2437079	16.5189528	16.7997864	17.0863242	14
15	16.6821378	16.9844494	17.2934169	17.6091913	17.9319267	18.2617805	18.5989139	15
16	17.9323698	18.2816772	18.6392853	19.0053981	19.3802248	19.7639795	20.1568813	16
17	19.2013554	19.6016066	20.0120710	20.4330196	20.8647305	21.3074889	21.7615877	17
18	20.4893757	20.9446347	21.4123124	21.8927625	22.3863487	22.8934449	23.4144354	18
19	21.7967164	22.3111658	22.8405586	23.3853497	23.9460074	24.5230146	25.1168684	19
20	23.1236671	23.7016112	24.2973698	24.9115200	25.5446576	26.1973975	26.8703745	20
21	24.4705221	25.1163894	25.7833172	26.4720292	27.1832741	27.9178259	28.6764857	21
22	25.8375799	26.5559262	27.2989835	28.0676499	28.8628559	29.6855662	30.5367803	22
23	27.2251436	28.0206549	28.8449632	29.6991720	30.5844273	31.5019192	32.4528837	23
24	28.6335208	29.5110164	30.4218625	31.3674034	32.3490380	33.3682220	34.4264702	24
25	30.0630236	31.0274592	32.0302997	33.0731700	34.1577639	35.2858481	36.4592643	25
26	31.5139690	32.5704397	33.6709057	34.8173163	36.0117080	37.2562089	38.5530423	26
27	32.9866785	34.1404224	35.3443238	36.6007059	37.9120007	39.2807547	40.7096335	27
28	34.4814787	35.7378798	37.0512103	38.4242218	39.8598008	41.3609754	42.9309225	28
29	35.9987009	37.3632927	38.7922345	40.2887668	41.8562958	43.4984022	45.2188502	29
30	37.5386814	39.0171503	40.5680792	42.1952640	43.9027032	45.6946083	47.5754157	30
31	39.1017616	40.6999504	42.3794408	44.1446575	46.0002707	47.9512100	50.0026782	31
32	40.6882880	42.4121996	44.2270296	46.1379123	48.1502775	50.2698683	52.5027585	32
33	42.2986123	44.1544131	46.1115702	48.1760153	50.3540345	52.6522897	55.0778413	33
34	43.9330915	45.9271153	48.0338016	50.2599756	52.6128853	55.1002277	57.7301765	34
35	45.5920879	47.7308398	49.9944776	52.3908251	54.9282074	57.6154839	60.4620818	35
36	47.2759692	49.5661295	51.9943672	54.5696186	57.3014126	60.1999097	63.2759443	36
37	48.9851087	51.4335368	54.0342545	56.7974351	59.7339479	62.8554072	66.1742226	37
38	50.7198854	53.3336236	56.1149396	59.0753774	62.2272966	65.5839309	69.1594493	38
39	52.4806837	55.2669621	58.2372384	61.4045733	64.7829791	68.3874890	72.2342328	39
40	54.2678939	57.2341339	60.4019832	63.7861762	67.4025535	71.2681450	75.4012597	40
41	56.0819123	59.2357312	62.6100228	66.2213652	70.0876174	74.2280190	78.6632975	41
42	57.9231410	61.2723565	64.8622233	68.7113459	72.8398078	77.2692895	82.0231965	42
43	59.7919881	63.3446228	67.1594678	71.2573512	75.6608030	80.3941950	85.4838923	43
44	61.6888679	65.4531537	69.5026571	73.8606416	78.5523231	83.6050353	89.0484091	44
45	63.6142010	67.5985839	71.8927103	76.5225061	81.5161312	86.9041738	92.7198614	45
46	65.5684140	69.7815591	74.3305645	79.2442624	84.5540344	90.2940386	96.5014572	46
47	67.5519402	72.0027364	76.8171758	82.0272583	87.6678853	93.7771246	100.3965010	47
48	69.5652193	74.2627843	79.3535193	84.8728717	90.8595824	97.3559956	104.4083960	48
49	71.6086976	76.5623830	81.9405897	87.7825113	94.1310720	101.0332854	108.5406479	49
50	73.6828280	78.9022247	84.5794015	90.7576178	97.4843488	104.8117008	112.7968673	50
51	75.7880705	81.2830136	87.2709895	93.7996642	100.9214575	108.6940226	117.1807733	51
52	77.9248915	83.7054664	90.0164093	96.9101566	104.4444940	112.6831082	121.6961965	52
53	80.0937649	86.1703120	92.8167375	100.0906351	108.0556063	116.7818937	126.3470824	53
54	82.2951714	88.6782925	95.6730722	103.3426744	111.7569965	120.9933957	131.1374949	54
55	84.5295989	91.2301626	98.5865337	106.6678846	115.5509214	125.3207141	136.0716197	55
56	86.7975429	93.8266904	101.5582643	110.0679120	119.4396944	129.7670338	141.1537683	56
57	89.0995061	96.4686575	104.5894296	113.5444400	123.4256868	134.3356272	146.3883814	57
58	91.4359987	99.1568590	107.6812182	117.0991899	127.5113289	139.0298569	151.7800328	58
59	93.8075386	101.8921041	110.8348426	120.7339217	131.6991122	143.8531780	157.3334338	59
60	96.2146517	104.6752159	114.0515394	124.4504349	135.9915900	148.8091404	163.0534368	60

TABLE 32.—*The accumulation of an annuity of 1 per annum at the end of n years*—Con.

$$s_{\overline{n}|} = \frac{(1+i)^n - 1}{i}$$

Yrs.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Yrs.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	2.0350000	2.0400000	2.0450000	2.0500000	2.0550000	2.0600000	2.0700000	2
3	3.1062250	3.1216000	3.1370250	3.1525000	3.1680250	3.1836000	3.2149000	3
4	4.2149429	4.2464640	4.2781911	4.3101250	4.3422664	4.3746160	4.4399430	4
5	5.3624659	5.4163226	5.4707097	5.5256313	5.5810910	5.6370930	5.7507390	5
6	6.5501522	6.6329755	6.7168917	6.8019128	6.8880510	6.9753185	7.1532907	6
7	7.7794075	7.8982945	8.0191518	8.1420085	8.2668938	8.3938377	8.6540211	7
8	9.0516868	9.2142263	9.3800136	9.5491089	9.7215730	9.8974679	10.2598026	8
9	10.3684958	10.5827953	10.8021142	11.0265643	11.2562595	11.4913160	11.9779888	9
10	11.7313932	12.0061071	12.2882094	12.5778925	12.8753538	13.1807949	13.8164480	10
11	13.1419919	13.4863514	13.8411788	14.2067872	14.5834983	14.9716426	15.7835993	11
12	14.6019616	15.0258055	15.4640318	15.9171265	16.3855907	16.8699412	17.8884513	12
13	16.1130303	16.6268377	17.1599133	17.7129829	18.2867981	18.8821377	20.1406429	13
14	17.6769864	18.2919112	18.9321094	19.5986320	20.2925720	21.0150659	22.5504879	14
15	19.2956809	20.0235876	20.7840543	21.5785636	22.4086635	23.2759699	25.1290220	15
16	20.9710297	21.8245311	22.7193367	23.6574918	24.6411400	25.6725281	27.8880536	16
17	22.7050158	23.6975124	24.7417069	25.8403064	26.9964027	28.2128798	30.8402173	17
18	24.4996913	25.6454129	26.8550837	28.1323847	29.4812048	30.9056526	33.9990325	18
19	26.3571805	27.6712294	29.0635625	30.5390039	32.1026711	33.7599917	37.3789648	19
20	28.2796818	29.7780786	31.3714228	33.0659541	34.8683180	36.7855912	40.9954923	20
21	30.2694707	31.9692017	33.7831368	35.7192518	37.7860755	39.9927267	44.8651768	21
22	32.3289022	34.2479698	36.3033780	38.5052144	40.8643097	43.3922903	49.0057392	22
23	34.4604137	36.6178886	38.9370300	41.4304751	44.1118467	46.9958277	53.4361409	23
24	36.6665282	39.0826041	41.6891963	44.5019989	47.5379983	50.8155774	58.1766708	24
25	38.9498567	41.6459083	44.5652102	47.7270988	51.1525882	54.8645120	63.2490377	25
26	41.3131017	44.3117446	47.5706446	51.1134538	54.9659805	59.1563827	68.6764704	26
27	43.7590602	47.0842144	50.7113236	54.6691265	58.9891094	63.7057657	74.4838233	27
28	46.2906273	49.9675830	53.9933332	58.4025828	63.2335105	68.5281116	80.6976909	28
29	48.9107993	52.9662863	57.4230332	62.3227119	67.7113535	73.6397983	87.3465293	29
30	51.6226773	56.0849378	61.0070697	66.4388475	72.4354780	79.0581862	94.4607863	30
31	54.4294710	59.3283353	64.7523878	70.7607899	77.4194293	84.8016774	102.0730414	31
32	57.3345025	62.7014687	68.6662452	75.2988294	82.6774579	90.8897780	110.2181543	32
33	60.3412101	66.2095274	72.7562263	80.0637708	88.2247603	97.3431647	118.9334251	33
34	63.4531524	69.8579085	77.0302565	85.0669594	94.0771221	104.1837546	128.2587648	34
35	66.6740127	73.6522249	81.4966180	90.3203074	100.2513638	111.4347799	138.2368784	35
36	70.0076032	77.5983139	86.1639658	95.8363227	106.7651888	119.1208667	148.9134598	36
37	73.4578693	81.7022464	91.0413443	101.6281389	113.6372742	127.2681187	160.3374020	37
38	77.0288947	85.9703363	96.1382048	107.7095458	120.8873243	135.9042058	172.5610202	38
39	80.7249060	90.4091497	101.4644240	114.0950231	128.5361271	145.0584581	185.6402916	39
40	84.5502778	95.0255157	107.0303231	120.7997742	136.6056141	154.7619656	199.6351120	40
41	88.5095375	99.8265363	112.8466876	127.8397630	145.1189229	165.0476836	214.6095698	41
42	92.6073713	104.8195978	118.9247885	135.2317511	154.1004636	175.9505446	230.6322397	42
43	96.8486293	110.0123817	125.2764040	142.9933387	163.5759891	187.5075772	247.7764695	43
44	101.2383313	115.4128770	131.9138422	151.1430056	173.5726685	199.7580319	266.1208513	44
45	105.7816729	121.0293920	138.8499651	159.7001559	184.1191653	212.7435138	285.7493108	45
46	110.4840315	126.8705677	146.0982135	168.6851637	195.2457194	226.5081246	306.7517626	46
47	115.3509726	132.9453904	153.6726331	178.1194219	206.9842339	241.0986121	329.2243860	47
48	120.3882566	139.2632060	161.5879016	188.0253929	219.3683668	256.5645288	353.2700930	48
49	125.6018456	145.8337343	169.8593572	198.4266626	232.4336270	272.9584006	378.9989995	49
50	130.9979102	152.6670837	178.5030283	209.3479957	246.2174765	290.3359046	406.5289295	50
51	136.5828370	159.7737670	187.5356646	220.8153955	260.7594377	308.7560589	435.9859545	51
52	142.3632363	167.1647177	196.9747695	232.8561653	276.1012067	328.2814224	467.5049714	52
53	148.3459496	174.8513064	206.8386341	245.4989735	292.2867731	348.9783077	501.2303194	53
54	154.5380578	182.8453587	217.1463726	258.7739222	309.3625456	370.9170062	537.3164417	54
55	160.9468898	191.1591730	227.9179594	272.7126183	327.3774856	394.1720266	575.9285926	55
56	167.5800310	199.8055399	239.1742676	287.3482492	346.3832473	418.8223482	617.2435941	56
57	174.4453321	208.7977615	250.9371096	302.7156617	366.4343259	444.9516891	661.4506457	57
58	181.5509187	218.1496720	263.2292795	318.8514448	387.5882139	472.6487904	708.7521909	58
59	188.9052009	227.8756589	276.0745971	335.7940170	409.9055656	502.0077178	759.3648443	59
60	196.5168829	237.9906852	289.4979540	353.5837179	433.4503717	533.1281809	813.5203834	60

TABLE 33.—*The annual sinking fund which will accumulate to 1 at the end of n years.*

$$\frac{1}{s_{\overline{n}|}} = \frac{i}{(1+i)^n - 1}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	0.4962779	0.4956630	0.4950495	0.4944376	0.4938272	0.4932183	0.4926108	2
3	0.3283830	0.3275675	0.3267547	0.3259446	0.3251372	0.3243324	0.3235304	3
4	0.2444448	0.2435324	0.2426238	0.2417189	0.2408179	0.2399206	0.2390271	4
5	0.1940893	0.1931214	0.1921584	0.1912002	0.1902469	0.1892983	0.1883546	5
6	0.1605252	0.1595226	0.1585258	0.1575350	0.1565500	0.1555708	0.1545975	6
7	0.1365562	0.1355306	0.1345120	0.1335003	0.1324954	0.1314975	0.1305064	7
8	0.1185840	0.1175429	0.1165098	0.1154846	0.1144674	0.1134580	0.1124564	8
9	0.1046098	0.1035581	0.1025154	0.1014817	0.1004569	0.0994410	0.0984339	9
10	0.0934342	0.0923753	0.0913265	0.0902877	0.0892588	0.0882397	0.0872305	10
11	0.0842938	0.0832304	0.0821779	0.0811365	0.0801060	0.0790863	0.0780775	11
12	0.0766800	0.0756138	0.0745596	0.0735174	0.0724871	0.0714687	0.0704621	12
13	0.0702404	0.0691728	0.0681184	0.0670769	0.0660483	0.0650325	0.0640295	13
14	0.0647233	0.0636556	0.0626020	0.0615623	0.0605365	0.0595246	0.0585263	14
15	0.0599444	0.0588774	0.0578255	0.0567885	0.0557665	0.0547592	0.0537666	15
16	0.0557651	0.0546996	0.0536501	0.0526166	0.0515990	0.0505971	0.0496109	16
17	0.0520797	0.0510162	0.0499698	0.0489404	0.0479278	0.0469319	0.0459525	17
18	0.0488058	0.0477449	0.0467021	0.0456772	0.0446701	0.0436806	0.0427087	18
19	0.0458785	0.0448206	0.0437818	0.0427618	0.0417606	0.0407780	0.0398139	19
20	0.0432457	0.0421912	0.0411567	0.0401421	0.0391471	0.0381717	0.0372157	20
21	0.0408655	0.0398146	0.0387848	0.0377757	0.0367873	0.0358194	0.0348718	21
22	0.0387033	0.0376564	0.0366314	0.0356282	0.0346466	0.0336864	0.0327474	22
23	0.0367308	0.0356878	0.0346681	0.0336710	0.0326964	0.0317441	0.0308139	23
24	0.0349241	0.0338857	0.0328711	0.0318802	0.0309128	0.0299686	0.0290474	24
25	0.0332635	0.0322295	0.0312204	0.0302360	0.0292759	0.0283400	0.0274279	25
26	0.0317320	0.0307027	0.0296992	0.0287213	0.0277687	0.0268412	0.0259383	26
27	0.0303153	0.0292908	0.0282931	0.0273219	0.0263769	0.0254578	0.0245642	27
28	0.0290011	0.0279815	0.0269897	0.0260253	0.0251879	0.0241774	0.0232932	28
29	0.0277788	0.0267642	0.0257784	0.0248208	0.0238913	0.0229894	0.0221147	29
30	0.0266392	0.0256298	0.0246499	0.0236993	0.0227776	0.0218844	0.0210193	30
31	0.0255743	0.0245701	0.0235964	0.0226528	0.0217390	0.0208545	0.0199989	31
32	0.0245771	0.0235781	0.0226106	0.0216742	0.0207683	0.0198926	0.0190466	32
33	0.0236414	0.0226478	0.0216865	0.0207572	0.0198594	0.0189925	0.0181561	33
34	0.0227619	0.0217736	0.0208187	0.0198966	0.0190068	0.0181488	0.0173220	34
35	0.0219336	0.0209508	0.0200022	0.0190873	0.0182056	0.0173565	0.0165393	35
36	0.0211524	0.0201751	0.0192329	0.0183252	0.0174516	0.0166113	0.0158038	36
37	0.0204144	0.0194426	0.0185068	0.0176064	0.0167409	0.0159095	0.0151116	37
38	0.0197161	0.0187499	0.0178206	0.0169275	0.0160701	0.0152476	0.0144593	38
39	0.0190546	0.0180940	0.0171711	0.0162854	0.0154362	0.0146226	0.0138439	39
40	0.0184271	0.0174721	0.0165558	0.0156774	0.0148362	0.0140315	0.0132624	40
41	0.0178311	0.0168817	0.0159719	0.0151009	0.0142679	0.0134720	0.0127124	41
42	0.0172643	0.0163206	0.0154173	0.0145536	0.0137288	0.0129418	0.0121917	42
43	0.0167247	0.0157867	0.0148899	0.0140336	0.0132169	0.0124387	0.0116981	43
44	0.0162104	0.0152781	0.0143879	0.0135390	0.0127304	0.0119610	0.0112298	44
45	0.0157198	0.0147932	0.0139096	0.0130681	0.0122675	0.0115069	0.0107852	45
46	0.0152512	0.0143304	0.0134534	0.0126192	0.0118268	0.0110749	0.0103625	46
47	0.0148034	0.0138884	0.0130179	0.0121911	0.0114067	0.0106636	0.0099605	47
48	0.0143750	0.0134657	0.0126018	0.0117823	0.0110060	0.0102716	0.0095778	48
49	0.0139648	0.0130612	0.0122040	0.0113918	0.0106235	0.0098977	0.0092131	49
50	0.0135717	0.0126739	0.0118232	0.0110184	0.0102581	0.0095409	0.0088655	50
51	0.0131947	0.0123027	0.0114586	0.0106610	0.0099087	0.0092001	0.0085338	51
52	0.0128329	0.0119467	0.0111091	0.0103188	0.0095745	0.0088744	0.0082172	52
53	0.0124854	0.0116049	0.0107739	0.0099909	0.0092545	0.0085630	0.0079147	53
54	0.0121514	0.0112767	0.0104523	0.0096765	0.0089480	0.0082649	0.0076256	54
55	0.0118302	0.0109613	0.0101434	0.0093749	0.0086542	0.0079795	0.0073491	55
56	0.0115211	0.0106580	0.0098466	0.0090853	0.0083724	0.0077061	0.0070845	56
57	0.0112234	0.0103661	0.0095612	0.0088071	0.0081020	0.0074440	0.0068311	57
58	0.0109366	0.0100850	0.0092867	0.0085398	0.0078424	0.0071927	0.0065885	58
59	0.0106601	0.0098143	0.0090224	0.0082827	0.0075931	0.0069515	0.0063559	59
60	0.0103934	0.0095534	0.0087680	0.0080353	0.0073534	0.0067200	0.0061330	60

TABLE 33.—*The annual sinking fund which will accumulate to 1 at the end of n years*—Continued.

$$\frac{1}{s\overline{n}|} = \frac{i}{(1+i)^n - 1}.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1
2	0.4914005	0.4901961	0.4889976	0.4878049	0.4866180	0.4854369	0.4830918	2
3	0.3219342	0.3203485	0.3187734	0.3172086	0.3156541	0.3141098	0.3110517	3
4	0.2372511	0.2354901	0.2337437	0.2320118	0.2302945	0.2285915	0.2252281	4
5	0.1864814	0.1846271	0.1827916	0.1809748	0.1791764	0.1773964	0.1738907	5
6	0.1526682	0.1507619	0.1488784	0.1470175	0.1451790	0.1433626	0.1397958	6
7	0.1285445	0.1266096	0.1247015	0.1228198	0.1209644	0.1191350	0.1155532	7
8	0.1104767	0.1085278	0.1066097	0.1047218	0.1028640	0.1010359	0.0974678	8
9	0.0964460	0.0944930	0.0925745	0.0906901	0.0888395	0.0870222	0.0834865	9
10	0.0852414	0.0832909	0.0813788	0.0795046	0.0776678	0.0758680	0.0723775	10
11	0.0760920	0.0741490	0.0722482	0.0703889	0.0685707	0.0667929	0.0633569	11
12	0.0684840	0.0665522	0.0646662	0.0628254	0.0610292	0.0592770	0.0559020	12
13	0.0620616	0.0601437	0.0582754	0.0564558	0.0546843	0.0529601	0.0496509	13
14	0.0565707	0.0546690	0.0528263	0.0510240	0.0492791	0.0475849	0.0443449	14
15	0.0518251	0.0499411	0.0481138	0.0463423	0.0446256	0.0429628	0.0397946	15
16	0.0476848	0.0458200	0.0440154	0.0422699	0.0405825	0.0389521	0.0358577	16
17	0.0440431	0.0421985	0.0404176	0.0386991	0.0370420	0.0354448	0.0324252	17
18	0.0408168	0.0389933	0.0372369	0.0355462	0.0339199	0.0323565	0.0294126	18
19	0.0379403	0.0361386	0.0344073	0.0327450	0.0311501	0.0296209	0.0267530	19
20	0.0353611	0.0335818	0.0318761	0.0302426	0.0286793	0.0271846	0.0243929	20
21	0.0330366	0.0312801	0.0296006	0.0279961	0.0264648	0.0250046	0.0222890	21
22	0.0309321	0.0291988	0.0275457	0.0259705	0.0244712	0.0230456	0.0204058	22
23	0.0290188	0.0273091	0.0256825	0.0241368	0.0226696	0.0212785	0.0187139	23
24	0.0272728	0.0255868	0.0239870	0.0224709	0.0210358	0.0196790	0.0171890	24
25	0.0256740	0.0240120	0.0224390	0.0209525	0.0195494	0.0182267	0.0158105	25
26	0.0242054	0.0225674	0.0210214	0.0195643	0.0181931	0.0169044	0.0145610	26
27	0.0228524	0.0212385	0.0197195	0.0182919	0.0169523	0.0156972	0.0134257	27
28	0.0216027	0.0200130	0.0185208	0.0171225	0.0158144	0.0145926	0.0123919	28
29	0.0204454	0.0188799	0.0174146	0.0160455	0.0147686	0.0135796	0.0114487	29
30	0.0193713	0.0178301	0.0163915	0.0150514	0.0138054	0.0126489	0.0105864	30
31	0.0183724	0.0168554	0.0154435	0.0141321	0.0129167	0.0117922	0.0097969	31
32	0.0174415	0.0159486	0.0145632	0.0132804	0.0120952	0.0110023	0.0090729	32
33	0.0165724	0.0151036	0.0137445	0.0124900	0.0113347	0.0102729	0.0084081	33
34	0.0157597	0.0143148	0.0129819	0.0117554	0.0106296	0.0095984	0.0077967	34
35	0.0149984	0.0135773	0.0122705	0.0110717	0.0099749	0.0089739	0.0072340	35
36	0.0142842	0.0128869	0.0116058	0.0104345	0.0093664	0.0083948	0.0067153	36
37	0.0136133	0.0122396	0.0109840	0.0098398	0.0087999	0.0078574	0.0062369	37
38	0.0129821	0.0116319	0.0104017	0.0092842	0.0082722	0.0073581	0.0057951	38
39	0.0123878	0.0110608	0.0098557	0.0087646	0.0077799	0.0068938	0.0053868	39
40	0.0118273	0.0105235	0.0093432	0.0082782	0.0073203	0.0064615	0.0050091	40
41	0.0112982	0.0100174	0.0088616	0.0078223	0.0068909	0.0060589	0.0046596	41
42	0.0107983	0.0095402	0.0084087	0.0073947	0.0064893	0.0056834	0.0043359	42
43	0.0103254	0.0090899	0.0079824	0.0069933	0.0061134	0.0053331	0.0040359	43
44	0.0098777	0.0086645	0.0075807	0.0066163	0.0057613	0.0050061	0.0037577	44
45	0.0094534	0.0082625	0.0072020	0.0062617	0.0054313	0.0047005	0.0034996	45
46	0.0090511	0.0078821	0.0068447	0.0059282	0.0051218	0.0044149	0.0032600	46
47	0.0086692	0.0075219	0.0065073	0.0056142	0.0048313	0.0041477	0.0030374	47
48	0.0083065	0.0071807	0.0061886	0.0053184	0.0045585	0.0038977	0.0028307	48
49	0.0079617	0.0068571	0.0058872	0.0050397	0.0043023	0.0036636	0.0026385	49
50	0.0076337	0.0065502	0.0056022	0.0047767	0.0040615	0.0034443	0.0024599	50
51	0.0073216	0.0062589	0.0053323	0.0045287	0.0038350	0.0032388	0.0022937	51
52	0.0070243	0.0059821	0.0050768	0.0042945	0.0036219	0.0030462	0.0021390	52
53	0.0067410	0.0057192	0.0048347	0.0040733	0.0034213	0.0028655	0.0019951	53
54	0.0064709	0.0054691	0.0046052	0.0038644	0.0032325	0.0026960	0.0018611	54
55	0.0062132	0.0052312	0.0043875	0.0036669	0.0030546	0.0025370	0.0017363	55
56	0.0059673	0.0050049	0.0041811	0.0034801	0.0028870	0.0023877	0.0016201	56
57	0.0057325	0.0047893	0.0039851	0.0033034	0.0027290	0.0022474	0.0015118	57
58	0.0055081	0.0045840	0.0037990	0.0031363	0.0025801	0.0021157	0.0014109	58
59	0.0052937	0.0043884	0.0036222	0.0029780	0.0024396	0.0019920	0.0013169	59
60	0.0050886	0.0042019	0.0034543	0.0028282	0.0023071	0.0018757	0.0012292	60

TABLE 34.—*The present value of 1 due in n years.*

$$v^n=(1+i)^{-n}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	0.9852217	0.9828010	0.9803922	0.9779951	0.9756098	0.9732360	0.9708738	1
2	0.9706618	0.9658978	0.9611688	0.9564744	0.9518144	0.9471883	0.9425959	2
3	0.9563170	0.9492853	0.9423223	0.9354273	0.9285994	0.9218378	0.9151417	3
4	0.9421842	0.9329585	0.9238454	0.9148434	0.9059506	0.8971657	0.8884871	4
5	0.9282603	0.9169125	0.9057308	0.8947123	0.8838543	0.8731540	0.8626088	5
6	0.9145422	0.9011425	0.8879714	0.8750243	0.8622969	0.8497849	0.8374843	6
7	0.9010268	0.8856438	0.8705602	0.8557695	0.8412652	0.8270413	0.8130915	7
8	0.8877111	0.8704116	0.8534904	0.8369384	0.8207466	0.8049064	0.7894092	8
9	0.8745922	0.8554414	0.8367553	0.8185216	0.8007284	0.7833639	0.7664167	9
10	0.8616672	0.8407286	0.8203483	0.8005101	0.7811984	0.7623979	0.7440939	10
11	0.8489332	0.8262689	0.8042630	0.7828950	0.7621448	0.7419931	0.7224213	11
12	0.8363874	0.8120579	0.7884932	0.7656675	0.7435559	0.7221344	0.7013799	12
13	0.8240270	0.7980913	0.7730325	0.7488191	0.7254204	0.7028072	0.6809513	13
14	0.8118493	0.7843649	0.7578750	0.7323414	0.7077272	0.6839973	0.6611178	14
15	0.7998515	0.7708746	0.7430147	0.7162263	0.6904656	0.6656908	0.6418620	15
16	0.7880310	0.7576163	0.7284458	0.7004658	0.6736249	0.6478742	0.6231669	16
17	0.7763853	0.7445861	0.7141626	0.6850521	0.6571951	0.6305345	0.6050165	17
18	0.7649116	0.7317799	0.7001594	0.6699776	0.6411659	0.6136589	0.5873946	18
19	0.7536075	0.7191940	0.6864308	0.6552348	0.6255277	0.5972350	0.5702860	19
20	0.7424704	0.7068246	0.6729713	0.6408165	0.6102709	0.5812506	0.5536758	20
21	0.7314980	0.6946679	0.6597758	0.6267154	0.5953863	0.5656940	0.5375493	21
22	0.7206876	0.6827203	0.6468390	0.6129246	0.5808647	0.5505538	0.5218925	22
23	0.7100371	0.6709782	0.6341559	0.5994372	0.5666972	0.5358187	0.5066918	23
24	0.6995439	0.6594380	0.6217215	0.5862467	0.5528754	0.5214781	0.4919337	24
25	0.6892058	0.6480963	0.6095309	0.5733464	0.5393906	0.5075213	0.4776056	25
26	0.6790205	0.6369497	0.5975793	0.5607300	0.5262347	0.4939380	0.4636947	26
27	0.6689857	0.6259948	0.5858620	0.5483912	0.5133997	0.4807182	0.4501891	27
28	0.6590993	0.6152283	0.5743746	0.5363239	0.5008778	0.4678523	0.4370768	28
29	0.6493589	0.6046470	0.5631123	0.5245221	0.4886613	0.4553307	0.4243464	29
30	0.6397624	0.5942476	0.5520709	0.5129801	0.4767427	0.4431442	0.4119868	30
31	0.6303078	0.5840272	0.5412460	0.5016920	0.4651148	0.4312839	0.3999872	31
32	0.6209929	0.5739825	0.5306333	0.4906523	0.4537706	0.4197410	0.3883370	32
33	0.6118157	0.5641105	0.5202287	0.4798556	0.4427030	0.4085071	0.3770263	33
34	0.6027741	0.5544084	0.5100282	0.4692964	0.4319053	0.3975738	0.3660449	34
35	0.5938661	0.5448731	0.5000276	0.4589696	0.4213711	0.3869331	0.3553834	35
36	0.5850897	0.5355018	0.4902232	0.4488700	0.4110937	0.3765773	0.3450324	36
37	0.5764431	0.5262917	0.4806109	0.4389927	0.4010671	0.3664986	0.3349829	37
38	0.5679242	0.5172400	0.4711872	0.4293327	0.3912849	0.3566896	0.3252262	38
39	0.5595313	0.5083440	0.4619482	0.4198853	0.3817414	0.3471432	0.3157536	39
40	0.5512623	0.4996010	0.4528904	0.4106458	0.3724306	0.3378522	0.3065568	40
41	0.5431156	0.4910083	0.4440102	0.4016095	0.3633470	0.3288100	0.2976280	41
42	0.5350893	0.4825635	0.4353041	0.3927722	0.3544848	0.3200097	0.2889592	42
43	0.5271815	0.4742639	0.4267688	0.3841293	0.3458389	0.3114450	0.2805429	43
44	0.5193907	0.4661070	0.4184007	0.3756765	0.3374038	0.3031094	0.2723718	44
45	0.5117149	0.4580904	0.4101968	0.3674098	0.3291744	0.2949970	0.2644386	45
46	0.5041527	0.4502117	0.4021537	0.3593250	0.3211458	0.2871017	0.2567365	46
47	0.4967021	0.4424685	0.3942684	0.3514181	0.3133129	0.2794177	0.2492588	47
48	0.4893617	0.4348585	0.3865376	0.3436852	0.3056712	0.2719394	0.2419988	48
49	0.4821298	0.4273793	0.3789584	0.3361224	0.2982158	0.2646612	0.2349503	49
50	0.4750047	0.4200288	0.3715279	0.3287261	0.2909422	0.2575778	0.2281071	50
51	0.4679849	0.4128048	0.3642430	0.3214925	0.2838461	0.2506840	0.2214632	51
52	0.4610689	0.4057049	0.3571010	0.3144181	0.2769230	0.2439747	0.2150128	52
53	0.4542551	0.3987272	0.3500990	0.3074994	0.2701688	0.2374450	0.2087503	53
54	0.4475419	0.3918695	0.3432343	0.3007329	0.2635793	0.2310900	0.2026702	54
55	0.4409280	0.3851297	0.3365043	0.2941153	0.2571505	0.2249051	0.1967672	55
56	0.4344118	0.3785059	0.3299061	0.2876433	0.2508786	0.2188858	0.1910361	56
57	0.4279919	0.3719959	0.3234374	0.2813137	0.2447596	0.2130275	0.1854719	57
58	0.4216669	0.3655980	0.3170955	0.2751235	0.2387898	0.2073260	0.1800698	58
59	0.4154354	0.3593100	0.3108779	0.2690694	0.2329657	0.2017772	0.1748251	59
60	0.4092960	0.3531303	0.3047823	0.2631486	0.2272836	0.1963768	0.1697331	60

TABLE 34.—*The present value of 1 due in n years*—Continued.

$$v^n = (1+i)^{-n}.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	0.9661836	0.9615385	0.9569378	0.9523810	0.9478673	0.9433962	0.9345794	1
2	0.9335107	0.9245562	0.9157300	0.9070295	0.8984524	0.8899964	0.8734387	2
3	0.9019427	0.8889964	0.8762966	0.8638376	0.8516137	0.8396193	0.8162979	3
4	0.8714422	0.8548042	0.8385613	0.8227025	0.8072167	0.7920937	0.7628952	4
5	0.8419732	0.8219271	0.8024511	0.7835262	0.7651344	0.7472582	0.7129862	5
6	0.8135006	0.7903145	0.7678957	0.7462154	0.7252458	0.7049605	0.6663422	6
7	0.7859910	0.7599178	0.7348285	0.7106813	0.6874368	0.6650571	0.6227497	7
8	0.7594116	0.7306902	0.7031851	0.6768394	0.6515989	0.6274124	0.5820091	8
9	0.7337310	0.7025867	0.6729044	0.6446089	0.6176293	0.5918985	0.5439337	9
10	0.7089188	0.6755642	0.6439277	0.6139133	0.5854306	0.5583948	0.5083493	10
11	0.6849457	0.6495809	0.6161987	0.5846793	0.5549105	0.5267875	0.4750928	11
12	0.6617833	0.6245971	0.5896639	0.5568374	0.5259815	0.4969694	0.4440120	12
13	0.6394042	0.6005741	0.5642716	0.5303214	0.4985607	0.4688390	0.4149645	13
14	0.6177818	0.5774751	0.5399729	0.5050680	0.4725694	0.4423010	0.3878172	14
15	0.5968906	0.5552645	0.5167204	0.4810171	0.4479331	0.4172651	0.3624460	15
16	0.5767059	0.5339082	0.4944693	0.4581115	0.4245811	0.3936463	0.3387346	16
17	0.5572038	0.5133733	0.4731764	0.4362967	0.4024465	0.3713644	0.3165744	17
18	0.5383611	0.4936281	0.4528004	0.4155207	0.3814659	0.3503438	0.2958639	18
19	0.5201557	0.4746424	0.4333018	0.3957340	0.3615791	0.3305130	0.2765083	19
20	0.5025659	0.4563870	0.4146429	0.3768895	0.3427290	0.3118047	0.2584190	20
21	0.4855709	0.4388336	0.3967874	0.3589424	0.3248616	0.2941554	0.2415131	21
22	0.4691506	0.4219554	0.3797009	0.3418499	0.3079257	0.2775051	0.2257132	22
23	0.4532856	0.4057263	0.3633501	0.3255713	0.2918727	0.2617973	0.2109469	23
24	0.4379571	0.3901215	0.3477035	0.3100679	0.2766566	0.2469786	0.1971466	24
25	0.4231470	0.3751168	0.3327306	0.2953028	0.2622337	0.2329986	0.1842492	25
26	0.4088377	0.3606892	0.3184025	0.2812407	0.2485628	0.2198100	0.1721955	26
27	0.3950122	0.3468166	0.3046914	0.2678483	0.2356045	0.2073680	0.1609304	27
28	0.3816543	0.3334775	0.2915707	0.2550936	0.2233218	0.1956301	0.1504022	28
29	0.3687482	0.3206514	0.2790150	0.2429463	0.2116794	0.1845567	0.1405628	29
30	0.3562784	0.3083187	0.2670000	0.2313775	0.2006440	0.1741101	0.1313671	30
31	0.3442304	0.2964603	0.2555024	0.2203595	0.1901839	0.1642548	0.1227730	31
32	0.3325897	0.2850579	0.2444999	0.2098662	0.1802691	0.1549574	0.1147411	32
33	0.3213427	0.2740942	0.2339712	0.1998725	0.1708712	0.1461862	0.1072347	33
34	0.3104761	0.2635521	0.2238959	0.1903548	0.1619632	0.1379115	0.1002193	34
35	0.2999769	0.2534155	0.2142544	0.1812903	0.1535196	0.1301052	0.0936629	35
36	0.2898327	0.2436687	0.2050282	0.1726574	0.1455162	0.1227408	0.0875355	36
37	0.2800316	0.2342969	0.1961992	0.1644356	0.1379301	0.1157932	0.0818088	37
38	0.2705619	0.2252854	0.1877504	0.1566054	0.1307394	0.1092389	0.0764569	38
39	0.2614125	0.2166206	0.1796655	0.1491480	0.1239236	0.1030555	0.0714550	39
40	0.2525725	0.2082890	0.1719287	0.1420457	0.1174631	0.0972222	0.0667804	40
41	0.2440314	0.2002779	0.1645251	0.1352816	0.1113395	0.0917191	0.0624116	41
42	0.2357791	0.1925749	0.1574403	0.1288396	0.1055350	0.0865274	0.0583286	42
43	0.2278059	0.1851682	0.1506605	0.1227044	0.1000332	0.0816296	0.0545127	43
44	0.2201023	0.1780464	0.1441728	0.1168613	0.0948182	0.0770091	0.0509464	44
45	0.2126592	0.1711984	0.1379644	0.1112965	0.0898751	0.0726501	0.0476135	45
46	0.2054679	0.1646139	0.1320233	0.1059967	0.0851897	0.0685378	0.0444986	46
47	0.1985197	0.1582826	0.1263381	0.1009492	0.0807485	0.0646583	0.0415875	47
48	0.1918065	0.1521948	0.1208977	0.0961421	0.0765389	0.0609984	0.0388668	48
49	0.1853202	0.1463411	0.1156916	0.0915639	0.0725487	0.0575457	0.0363241	49
50	0.1790534	0.1407126	0.1107097	0.0872037	0.0687665	0.0542884	0.0339478	50
51	0.1729984	0.1353006	0.1059423	0.0830512	0.0651815	0.0512154	0.0317269	51
52	0.1671482	0.1300967	0.1013801	0.0790964	0.0617834	0.0483165	0.0296513	52
53	0.1614959	0.1250930	0.0970145	0.0753299	0.0585625	0.0455816	0.0277115	53
54	0.1560347	0.1202817	0.0928368	0.0717427	0.0555095	0.0430015	0.0258986	54
55	0.1507581	0.1156555	0.0888391	0.0683264	0.0526156	0.0405674	0.0242043	55
56	0.1456600	0.1112072	0.0850135	0.0650728	0.0498726	0.0382712	0.0226208	56
57	0.1407343	0.1069300	0.0813526	0.0619741	0.0472726	0.0361049	0.0211410	57
58	0.1359752	0.1028173	0.0778494	0.0590229	0.0448082	0.0340612	0.0197579	58
59	0.1313770	0.0988628	0.0744970	0.0562123	0.0424722	0.0321332	0.0184653	59
60	0.1269343	0.0950604	0.0712890	0.0535355	0.0402580	0.0303143	0.0172573	60

TABLE 35.—*The present value of an annuity of 1 for n years.*

$$a_{\overline{n}|} = \frac{1-v^n}{i}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	0.9852217	0.9828010	0.9803922	0.9779951	0.9756098	0.9732360	0.9708738	1
2	1.9558834	1.9486988	1.9415609	1.9344696	1.9274242	1.9204243	1.9134697	2
3	2.9122004	2.8979840	2.8838833	2.8698969	2.8560236	2.8422621	2.8286114	3
4	3.8543847	3.8309425	3.8077287	3.7847402	3.7619742	3.7394279	3.7170984	4
5	4.7826450	4.7478551	4.7134595	4.6794525	4.6458285	4.6125819	4.5797072	5
6	5.6971872	5.6489976	5.6014309	5.5544768	5.5081254	5.4623668	5.4171914	6
7	6.5982140	6.5346414	6.4719911	6.4102463	6.3493906	6.2894081	6.2302830	7
8	7.4859251	7.4050530	7.3254814	7.2471846	7.1701372	7.0943144	7.0196922	8
9	8.3605173	8.2604943	8.1622367	8.0657062	7.9708655	7.8776783	7.7861089	9
10	9.2221846	9.1012229	8.9825850	8.8662164	8.7520639	8.6400762	8.5302028	10
11	10.0711178	9.9274918	9.7868481	9.6491113	9.5142087	9.3820693	9.2526241	11
12	10.9075052	10.7395497	10.5753412	10.4147788	10.2577646	10.1042037	9.9540040	12
13	11.7315322	11.5376410	11.3483738	11.1635979	10.9831850	10.8070109	10.6349553	13
14	12.5433815	12.3220059	12.1062488	11.8959392	11.6909122	11.4910081	11.2960731	14
15	13.3432330	13.0928805	12.8492635	12.6121055	12.3813777	12.1566989	11.9379351	15
16	14.1312641	13.8504968	13.5777093	13.3126313	13.0550027	12.8045732	12.5611020	16
17	14.9076493	14.5950828	14.2918719	13.9976834	13.7121977	13.4351077	13.1661185	17
18	15.6725609	15.3268627	14.9920313	14.6676611	14.3533636	14.0487666	13.7535131	18
19	16.4261684	16.0460567	15.6784620	15.3228959	14.9788913	14.6460016	14.3237991	19
20	17.1686388	16.7528813	16.3514333	15.9637124	15.5891623	15.2272521	14.8774749	20
21	17.9001367	17.4475492	17.0112092	16.5904278	16.1845486	15.7929461	15.4150241	21
22	18.6208244	18.1302695	17.6580482	17.2033523	16.7654132	16.3434999	15.9369166	22
23	19.3308615	18.8012476	18.2922041	17.8027896	17.3321105	16.8793186	16.4436084	23
24	20.0304054	19.4606857	18.9139256	18.3890362	17.8849858	17.4007967	16.9355421	24
25	20.7196112	20.1087820	19.5234565	18.9623826	18.4243764	17.9083180	17.4131477	25
26	21.3986317	20.7457317	20.1210358	19.5231126	18.9506111	18.4022559	17.8768424	26
27	22.0676175	21.3717264	20.7068978	20.0715038	19.4640109	18.8829741	18.3270315	27
28	22.7267167	21.9869547	21.2812724	20.6078276	19.9648887	19.3508264	18.7641082	28
29	23.3760756	22.5916017	21.8443847	21.1323498	20.4535499	19.8061571	19.1884546	29
30	24.0158380	23.1858493	22.3964556	21.6453299	20.9302926	20.2493013	19.6004414	30
31	24.6461458	23.7698765	22.9377015	22.1470219	21.3954074	20.6805852	20.0004285	31
32	25.2671387	24.3438590	23.4683348	22.6376742	21.8491780	21.1003262	20.3887655	32
33	25.8789544	24.9079695	23.9885636	23.1175298	22.2918809	21.5088333	20.7657918	33
34	26.4817285	25.4623779	24.4985917	23.5868262	22.7237863	21.9064071	21.1318367	34
35	27.0755946	26.0072510	24.9986193	24.0457958	23.1451573	22.2933403	21.4872201	35
36	27.6606843	26.5427528	25.4888425	24.4946658	23.5562511	22.6699175	21.8322525	36
37	28.2371274	27.0690446	25.9694534	24.9336585	23.9573181	23.0364161	22.1672354	37
38	28.8050516	27.5862846	26.4406406	25.3629912	24.3486030	23.3931057	22.4924616	38
39	29.3645829	28.0946286	26.9025888	25.7828765	24.7303444	23.7402488	22.8082151	39
40	29.9158452	28.5942296	27.3554792	26.1935222	25.1027751	24.0781011	23.1147720	40
41	30.4589608	29.0852379	27.7994895	26.5951317	25.4661220	24.4069110	23.4124000	41
42	30.9940500	29.5678014	28.2347936	26.9879039	25.8206068	24.7269207	23.7013592	42
43	31.5212316	30.0420652	28.6615623	27.3720332	26.1664457	25.0383656	23.9819021	43
44	32.0406222	30.5081722	29.0799631	27.7477097	26.5038495	25.3414751	24.2542739	44
45	32.5523372	30.9662626	29.4901599	28.1151195	26.8330239	25.6364721	24.5187125	45
46	33.0564898	31.4164743	29.8923136	28.4744445	27.1541696	25.9235738	24.7754491	46
47	33.5531920	31.8589428	30.2865820	28.8258626	27.4674826	26.2029915	25.0247078	47
48	34.0425537	32.2938013	30.6731196	29.1695478	27.7731537	26.4749309	25.2667066	48
49	34.5246834	32.7211806	31.0520780	29.5056702	28.0713695	26.7395922	25.5016569	49
50	34.9996881	33.1412095	31.4236059	29.8343963	28.3623117	26.9971700	25.7296640	50
51	35.4676730	33.5540142	31.7878489	30.1558888	28.6461577	27.2478540	25.9512272	51
52	35.9287419	33.9597191	32.1449499	30.4703069	28.9230807	27.4918287	26.1662400	52
53	36.3829969	34.3584463	32.4950489	30.7778062	29.1932495	27.7292737	26.3749903	53
54	36.8305388	34.7503158	32.8382833	31.0785391	29.4568288	27.9603637	26.5776605	54
55	37.2714668	35.1354455	33.1747875	31.3726544	29.7139793	28.1852688	26.7744276	55
56	37.7058786	35.5139514	33.5046937	31.6602977	29.9648578	28.4041545	26.9654637	56
57	38.1338706	35.8859473	33.8281310	31.9416114	30.2096174	28.6171820	27.1509357	57
58	38.5555375	36.2515452	34.1452265	32.2167349	30.4484072	28.8245081	27.3310055	58
59	38.9709729	36.6108553	34.4561044	32.4858043	30.6813729	29.0262852	27.5058306	59
60	39.3802689	36.9639855	34.7608867	32.7489529	30.9086565	29.2226620	27.6755637	60

TABLE 35.—*The present value of an annuity of 1 for n years*—Continued.

$$a_{\overline{n}|} = \frac{1 - v^n}{i}.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	0.9661836	0.9615385	0.9569378	0.9523810	0.9478673	0.9433962	0.9345794	1
2	1.8996943	1.8860947	1.8726678	1.8594104	1.8463197	1.8333927	1.8080182	2
3	2.8016370	2.7750910	2.7489644	2.7232480	2.6979334	2.6730120	2.6243160	3
4	3.6730792	3.6298952	3.5875257	3.5459505	3.5051501	3.4651056	3.3872113	4
5	4.5150524	4.4518223	4.3899767	4.3294767	4.2702845	4.2123638	4.1001974	5
6	5.3285530	5.2421369	5.1578725	5.07569 3	4.9955303	4.9173243	4.7665397	6
7	6.1145440	6.0020547	5.8927009	5.7863731	5.6829671	5.5823814	5.3892894	7
8	6.8739555	6.7327449	6.5958861	6.4632128	6.3345660	6.2097938	5.9712985	8
9	7.6076865	7.4353316	7.2687905	7.1078217	6.9521953	6.8016923	6.5152323	9
10	8.3166053	8.1108958	7.9127182	7.7217349	7.5376258	7.3600871	7.0235816	10
11	9.0015510	8.7604767	8.5289169	8.3064142	8.0925363	7.8868746	7.4986744	11
12	9.6633343	9.3850738	9.1185808	8.8632516	8.6185179	8.3838439	7.9426863	12
13	10.3027385	9.9856479	9.6828524	9.3935730	9.1170785	8.8526830	8.3576508	13
14	10.9205203	10.5631229	10.2228253	9.8986409	9.5896479	9.2949839	8.7454680	14
15	11.5174109	11.1183874	10.7395457	10.3796580	10.0375809	9.7122490	9.1079140	15
16	12.0941168	11.6522956	11.2340151	10.8377696	10.4621620	10.1058953	9.4466486	16
17	12.6513206	12.1656689	11.7071914	11.2740663	10.8646086	10.4772597	9.7632230	17
18	13.1896817	12.6592970	12.1599918	11.6895869	11.2460745	10.8276035	10.0590869	18
19	13.7098374	13.1339394	12.5932936	12.0853209	11.6076535	11.1581165	10.3355953	19
20	14.2124033	13.5903263	13.0079365	12.4622103	11.9503825	11.4699212	10.5940143	20
21	14.6979742	14.0291600	13.4047239	12.8211527	12.2752441	11.7640766	10.8355273	21
22	15.1671248	14.4511153	13.7844248	13.1630026	12.5831697	12.0415817	11.0612405	22
23	15.6204105	14.8568417	14.1477749	13.4885739	12.8750424	12.3033790	11.2721874	23
24	16.0583676	15.2469631	14.4954784	13.7986418	13.1516990	12.5503575	11.4693340	24
25	16.4815146	15.6220799	14.8282090	14.0939446	13.4139327	12.7833562	11.6535832	25
26	16.8903523	15.9827692	15.1466115	14.3751853	13.6624954	13.0031662	11.8257787	26
27	17.2853645	16.3295858	15.4513028	14.6430336	13.8980999	13.2105341	11.9867091	27
28	17.6670189	16.6630632	15.7428735	14.8981273	14.1214217	13.4061643	12.1371113	28
29	18.0357670	16.9837146	16.0218885	15.1410736	14.3331012	13.5907210	12.2776741	29
30	18.3920454	17.2920333	16.2888885	15.3724510	14.5337452	13.7648312	12.4090412	30
31	18.7362758	17.5884936	16.5443910	15.5928105	14.7239291	13.9290860	12.5318142	31
32	19.0688655	17.8735515	16.7888909	15.8026767	14.9041982	14.0840434	12.6465553	32
33	19.3902082	18.1476457	17.0228621	16.0025492	15.0750694	14.2302296	12.7537900	33
34	19.7006842	18.4111978	17.2467580	16.1929040	15.2370326	14.3681411	12.8540094	34
35	20.0006611	18.6646132	17.4610124	16.3741943	15.3905522	14.4982464	12.9476723	35
36	20.2904938	18.9082820	17.6660406	16.5468517	15.5360684	14.6209871	13.0352078	36
37	20.5705254	19.1425788	17.8622398	16.7112873	15.6739985	14.7367803	13.1170166	37
38	20.8410874	19.3678642	18.0499902	16.8678927	15.8047379	14.8460192	13.1934735	38
39	21.1024999	19.5844848	18.2296557	17.0170407	15.9286615	14.9490747	13.2649285	39
40	21.3550723	19.7927739	18.4015844	17.1590864	16.0461247	15.0462969	13.3317089	40
41	21.5991037	19.9930518	18.5661095	17.2943680	16.1574642	15.1380159	13.3941204	41
42	21.8348828	20.1856267	18.7235498	17.4232076	16.2629992	15.2245433	13.4524490	42
43	22.0626887	20.3707949	18.8742103	17.5459120	16.3630324	15.3061729	13.5069617	43
44	22.2827910	20.5488413	19.0183831	17.6627733	16.4578506	15.3831820	13.5579081	44
45	22.4954503	20.7200397	19.1563474	17.7740698	16.5477257	15.4558321	13.6055216	45
46	22.7009181	20.8846536	19.2883707	17.8800665	16.6329154	15.5243699	13.6500202	46
47	22.8994378	21.0429361	19.4147088	17.9810157	16.7136639	15.5890282	13.6916077	47
48	23.0912443	21.1951309	19.5356065	18.0771578	16.7902027	15.6500266	13.7304744	48
49	23.2765645	21.3414720	19.6512981	18.1687217	16.8627514	15.7075723	13.7667986	49
50	23.4556179	21.4821846	19.7620078	18.2559255	16.9315179	15.7618606	13.8007463	50
51	23.6286163	21.6174852	19.8679500	18.3389766	16.9966994	15.8130761	13.8324732	51
52	23.7957645	21.7475819	19.9693302	18.4180730	17.0584829	15.8613925	13.8621245	52
53	23.9572604	21.8726749	20.0663447	18.4934028	17.1170454	15.9069741	13.8898359	53
54	24.1132951	21.9929567	20.1591815	18.5651456	17.1725549	15.9499755	13.9157345	54
55	24.2640532	22.1086122	20.2480206	18.6334720	17.2251705	15.9905430	13.9399388	55
56	24.4097133	22.2198194	20.3330340	18.6985447	17.2750431	16.0288141	13.9625596	56
57	24.5504476	22.3267494	20.4143866	18.7605188	17.3223158	16.0649190	13.9837006	57
58	24.6864228	22.4295668	20.4922360	18.8195417	17.3671239	16.0989802	14.0034585	58
59	24.8177998	22.5284296	20.5667330	18.8757540	17.4095961	16.1311134	14.0219238	59
60	24.9447341	22.6234900	20.6380220	18.9292895	17.4498542	16.1614277	14.0391812	60

TABLE 36.—*The annuity for n years which 1 will buy or the annuity needed to discharge a debt of 1 in n years with interest.*

$$\frac{1}{a_{\overline{n}|}} = \frac{i}{1-v^n}.$$

Years.	1½%.	1¾%.	2%.	2¼%.	2½%.	2¾%.	3%.	Years.
1	1.0150000	1.0175000	1.0200000	1.0225000	1.0250000	1.0275000	1.0300000	1
2	0.5112779	0.5131630	0.5150495	0.5169376	0.5188272	0.5207183	0.5226108	2
3	0.3433830	0.3450675	0.3467547	0.3484446	0.3501372	0.3518324	0.3535304	3
4	0.2594448	0.2610324	0.2626238	0.2642189	0.2658179	0.2674206	0.2690271	4
5	0.2090893	0.2106214	0.2121584	0.2137002	0.2152469	0.2167983	0.2183546	5
6	0.1755252	0.1770226	0.1785258	0.1800350	0.1815500	0.1830708	0.1845975	6
7	0.1515562	0.1530306	0.1545120	0.1560003	0.1574954	0.1589975	0.1605064	7
8	0.1335840	0.1350429	0.1365098	0.1379846	0.1394674	0.1409580	0.1424564	8
9	0.1196098	0.1210581	0.1225154	0.1239817	0.1254569	0.1269410	0.1284339	9
10	0.1084342	0.1098754	0.1113265	0.1127877	0.1142588	0.1157397	0.1172305	10
11	0.0992938	0.1007304	0.1021779	0.1036365	0.1051060	0.1065863	0.1080775	11
12	0.0916800	0.0931138	0.0945596	0.0960174	0.0974871	0.0989687	0.1004621	12
13	0.0852404	0.0866728	0.0881184	0.0895769	0.0910483	0.0925325	0.0940295	13
14	0.0797233	0.0811556	0.0826020	0.0840623	0.0855365	0.0870246	0.0885263	14
15	0.0749444	0.0763774	0.0778255	0.0792885	0.0807665	0.0822592	0.0837666	15
16	0.0707651	0.0721996	0.0736501	0.0751166	0.0765990	0.0780971	0.0796109	16
17	0.0670797	0.0685162	0.0699698	0.0714404	0.0729278	0.0744319	0.0759525	17
18	0.0638058	0.0652449	0.0667021	0.0681772	0.0696701	0.0711806	0.0727087	18
19	0.0608785	0.0623206	0.0637818	0.0652618	0.0667606	0.0682780	0.0698139	19
20	0.0582457	0.0596912	0.0611567	0.0626421	0.0641471	0.0656717	0.0672157	20
21	0.0558655	0.0573146	0.0587848	0.0602757	0.0617873	0.0633194	0.0648718	21
22	0.0537033	0.0551564	0.0566314	0.0581282	0.0596466	0.0611864	0.0627474	22
23	0.0517308	0.0531880	0.0546681	0.0561710	0.0576964	0.0592441	0.0608139	23
24	0.0499241	0.0513857	0.0528711	0.0543802	0.0559128	0.0574686	0.0590474	24
25	0.0482635	0.0497295	0.0512204	0.0527360	0.0542759	0.0558400	0.0574279	25
26	0.0467320	0.0482027	0.0496992	0.0512213	0.0527688	0.0543412	0.0559383	26
27	0.0453153	0.0467908	0.0482931	0.0498219	0.0513769	0.0529578	0.0545642	27
28	0.0440011	0.0454815	0.0469897	0.0485253	0.0500879	0.0516774	0.0532932	28
29	0.0427788	0.0442642	0.0457784	0.0473208	0.0488913	0.0504894	0.0521147	29
30	0.0416392	0.0431298	0.0446499	0.0461993	0.0477776	0.0493844	0.0510193	30
31	0.0405743	0.0420701	0.0435963	0.0451528	0.0467390	0.0483545	0.0499989	31
32	0.0395771	0.0410781	0.0426106	0.0441742	0.0457683	0.0473926	0.0490466	32
33	0.0386414	0.0401478	0.0416865	0.0432572	0.0448594	0.0464925	0.0481561	33
34	0.0377619	0.0392736	0.0408187	0.0423966	0.0440068	0.0456488	0.0473220	34
35	0.0369336	0.0384508	0.0400022	0.0415873	0.0432056	0.0448565	0.0465393	35
36	0.0361524	0.0376751	0.0392329	0.0408252	0.0424516	0.0441113	0.0458038	36
37	0.0354144	0.0369426	0.0385068	0.0401064	0.0417409	0.0434095	0.0451116	37
38	0.0347161	0.0362499	0.0378206	0.0394275	0.0410701	0.0427476	0.0444593	38
39	0.0340546	0.0355940	0.0371711	0.0387854	0.0404362	0.0421226	0.0438439	39
40	0.0334271	0.0349721	0.0365558	0.0381774	0.0398362	0.0415315	0.0432624	40
41	0.0328311	0.0343817	0.0359719	0.0376009	0.0392679	0.0409720	0.0427124	41
42	0.0322643	0.0338206	0.0354173	0.0370536	0.0387288	0.0404418	0.0421917	42
43	0.0317247	0.0332867	0.0348899	0.0365336	0.0382169	0.0399387	0.0416981	43
44	0.0312104	0.0327781	0.0343879	0.0360390	0.0377304	0.0394610	0.0412299	44
45	0.0307198	0.0322932	0.0339096	0.0355681	0.0372675	0.0390069	0.0407852	45
46	0.0302512	0.0318304	0.0334534	0.0351192	0.0368268	0.0385749	0.0403625	46
47	0.0298034	0.0313884	0.0330179	0.0346911	0.0364067	0.0381636	0.0399605	47
48	0.0293750	0.0309657	0.0326018	0.0342823	0.0360060	0.0377716	0.0395778	48
49	0.0289648	0.0305612	0.0322040	0.0338918	0.0356235	0.0373977	0.0392131	49
50	0.0285717	0.0301739	0.0318232	0.0335184	0.0352581	0.0370409	0.0388655	50
51	0.0281947	0.0298027	0.0314586	0.0331610	0.0349087	0.0367001	0.0385338	51
52	0.0278329	0.0294466	0.0311091	0.0328188	0.0345745	0.0363744	0.0382172	52
53	0.0274854	0.0291049	0.0307739	0.0324909	0.0342545	0.0360630	0.0379147	53
54	0.0271514	0.0287767	0.0304523	0.0321765	0.0339480	0.0357649	0.0376256	54
55	0.0268302	0.0284613	0.0301434	0.0318749	0.0336542	0.0354795	0.0373491	55
56	0.0265211	0.0281580	0.0298466	0.0315853	0.0333724	0.0352061	0.0370845	56
57	0.0262234	0.0278661	0.0295612	0.0313071	0.0331020	0.0349440	0.0368311	57
58	0.0259366	0.0275850	0.0292867	0.0310398	0.0328424	0.0346927	0.0365885	58
59	0.0256601	0.0273143	0.0290224	0.0307827	0.0325931	0.0344515	0.0363559	59
60	0.0253934	0.0270534	0.0287680	0.0305353	0.0323534	0.0342200	0.0361330	60

TABLE 36.—*The annuity for n years which 1 will buy or the annuity needed to discharge a debt of 1 in n years with interest*—Continued.

$$\frac{1}{a_{\overline{n}|}} = \frac{i}{1-v^n}.$$

Years.	3½%.	4%.	4½%.	5%.	5½%.	6%.	7%.	Years.
1	1.0350000	1.0400000	1.0450000	1.0500000	1.0550000	1.0600000	1.0700000	1
2	0.5264005	0.5301961	0.5339976	0.5378049	0.5416180	0.5454369	0.5530918	2
3	0.3569342	0.3603485	0.3637734	0.3672086	0.3706541	0.3741098	0.3810517	3
4	0.2722511	0.2754901	0.2787437	0.2820118	0.2852945	0.2885915	0.2952281	4
5	0.2214814	0.2246271	0.2277916	0.2309748	0.2341764	0.2373964	0.2438907	5
6	0.1876682	0.1907619	0.1938784	0.1970175	0.2001790	0.2033626	0.2097958	6
7	0.1635445	0.1666096	0.1697015	0.1728198	0.1759644	0.1791350	0.1855532	7
8	0.1454767	0.1485278	0.1516097	0.1547218	0.1578640	0.1610359	0.1674678	8
9	0.1314460	0.1344930	0.1375745	0.1406901	0.1438395	0.1470222	0.1534865	9
10	0.1202414	0.1232909	0.1263788	0.1295046	0.1326678	0.1358680	0.1423775	10
11	0.1110920	0.1141490	0.1172482	0.1203889	0.1235707	0.1267929	0.1333569	11
12	0.1034840	0.1065522	0.1096662	0.1128254	0.1160292	0.1192770	0.1259020	12
13	0.0970616	0.1001437	0.1032754	0.1064558	0.1096843	0.1129601	0.1196509	13
14	0.0915707	0.0946690	0.0978203	0.1010240	0.1042791	0.1075849	0.1143449	14
15	0.0868251	0.0899411	0.0931138	0.0963423	0.0996256	0.1029628	0.1097946	15
16	0.0826848	0.0858200	0.0890154	0.0922699	0.0955825	0.0989521	0.1058577	16
17	0.0790431	0.0821985	0.0854176	0.0886999	0.0920420	0.0954448	0.1024252	17
18	0.0758168	0.0789933	0.0822369	0.0855462	0.0889199	0.0923565	0.0994126	18
19	0.0729403	0.0761386	0.0794073	0.0827450	0.0861501	0.0896209	0.0967530	19
20	0.0703611	0.0735818	0.0768761	0.0802426	0.0836793	0.0871846	0.0943929	20
21	0.0680366	0.0712801	0.0746006	0.0779961	0.0814648	0.0850046	0.0922890	21
22	0.0659321	0.0691988	0.0725457	0.0759705	0.0794712	0.0830456	0.0904058	22
23	0.0640188	0.0673091	0.0706825	0.0741368	0.0776696	0.0812785	0.0887139	23
24	0.0622728	0.0655868	0.0689870	0.0724709	0.0760358	0.0796790	0.0871890	24
25	0.0606740	0.0640120	0.0674390	0.0709525	0.0745494	0.0782267	0.0858105	25
26	0.0592054	0.0625674	0.0660214	0.0695643	0.0731931	0.0769044	0.0845610	26
27	0.0578524	0.0612385	0.0647195	0.0682919	0.0719523	0.0756972	0.0834257	27
28	0.0566027	0.0600130	0.0635208	0.0671225	0.0708144	0.0745926	0.0823919	28
29	0.0554454	0.0588799	0.0624146	0.0660455	0.0697686	0.0735796	0.0814487	29
30	0.0543713	0.0578301	0.0613915	0.0650514	0.0688054	0.0726489	0.0805864	30
31	0.0533724	0.0568554	0.0604435	0.0641321	0.0679167	0.0717922	0.0797969	31
32	0.0524415	0.0559486	0.0595632	0.0632804	0.0670952	0.0710023	0.0790729	32
33	0.0515724	0.0551036	0.0587445	0.0624900	0.0663347	0.0702729	0.0784081	33
34	0.0507597	0.0543148	0.0579819	0.0617554	0.0656296	0.0695984	0.0777967	34
35	0.0499984	0.0535773	0.0572705	0.0610717	0.0649749	0.0689739	0.0772340	35
36	0.0492842	0.0528869	0.0566058	0.0604345	0.0643664	0.0683948	0.0767153	36
37	0.0486133	0.0522396	0.0559840	0.0598398	0.0637999	0.0678574	0.0762369	37
38	0.0479821	0.0516319	0.0554017	0.0592842	0.0632722	0.0673581	0.0757951	38
39	0.0473878	0.0510608	0.0548557	0.0587646	0.0627799	0.0668938	0.0753868	39
40	0.0468273	0.0505235	0.0543432	0.0582782	0.0623203	0.0664615	0.0750091	40
41	0.0462982	0.0500174	0.0538616	0.0578223	0.0618909	0.0660589	0.0746596	41
42	0.0457983	0.0495402	0.0534087	0.0573947	0.0614893	0.0656834	0.0743359	42
43	0.0453254	0.0490899	0.0529824	0.0569933	0.0611134	0.0653331	0.0740359	43
44	0.0448777	0.0486645	0.0525807	0.0566163	0.0607613	0.0650061	0.0737577	44
45	0.0444534	0.0482625	0.0522020	0.0562617	0.0604313	0.0647005	0.0734996	45
46	0.0440511	0.0478821	0.0518447	0.0559282	0.0601218	0.0644149	0.0732600	46
47	0.0436692	0.0475219	0.0515073	0.0556142	0.0598313	0.0641477	0.0730374	47
48	0.0433065	0.0471807	0.0511886	0.0553184	0.0595585	0.0638977	0.0728307	48
49	0.0429617	0.0468571	0.0508872	0.0550397	0.0593023	0.0636636	0.0726385	49
50	0.0426337	0.0465502	0.0506022	0.0547767	0.0590615	0.0634443	0.0724599	50
51	0.0423216	0.0462589	0.0503323	0.0545287	0.0588350	0.0632388	0.0722937	51
52	0.0420243	0.0459821	0.0500768	0.0542945	0.0586219	0.0630462	0.0721390	52
53	0.0417410	0.0457192	0.0498347	0.0540733	0.0584213	0.0628655	0.0719951	53
54	0.0414709	0.0454691	0.0496052	0.0538644	0.0582325	0.0626960	0.0718611	54
55	0.0412132	0.0452312	0.0493875	0.0536669	0.0580546	0.0625370	0.0717363	55
56	0.0409673	0.0450049	0.0491811	0.0534801	0.0578870	0.0623877	0.0716201	56
57	0.0407325	0.0447893	0.0489851	0.0533034	0.0577290	0.0622474	0.0715118	57
58	0.0405081	0.0445840	0.0487990	0.0531363	0.0575801	0.0621157	0.0714109	58
59	0.0402937	0.0443884	0.0486222	0.0529780	0.0574396	0.0619920	0.0713169	59
60	0.0400886	0.0442019	0.0484543	0.0528282	0.0573071	0.0618757	0.0712292	60

TABLE 37.—*Bid on a bond for $100 to realize a given net income, interest payable semiannually.*

Net income.	5 years.	10 years.	15 years.	20 years.	25 years.	30 years.
			INTEREST 3½%.			
3.00	102.31	104.29	106.00	107.48	108.75	109.85
3.10	101.84	103.42	104.77	105.93	106.92	107.78
3.20	101.38	102.55	103.55	104.41	105.14	105.76
3.30	100.91	101.69	102.35	102.91	103.39	103.79
3.40	100.46	100.84	101.17	101.44	101.68	101.87
3.50	100.00	100.00	100.00	100.00	100.00	100.00
3.60	99.55	99.17	98.85	98.58	98.36	98.17
3.70	99.09	98.34	97.71	97.19	96.76	96.39
3.80	98.65	97.52	96.59	95.82	95.19	94.66
3.90	98.20	96.71	95.49	94.48	93.65	92.96
4.00	97.75	95.91	94.40	93.16	92.14	91.31
4.10	97.31	95.12	93.33	91.86	90.67	89.70
4.20	96.87	94.33	92.27	90.59	89.23	88.12
4.30	96.44	93.55	91.22	89.34	87.82	86.59
4.40	96.00	92.78	90.19	88.11	86.44	85.09
4.50	95.57	92.02	89.18	86.90	85.08	83.63
4.60	95.14	91.26	88.18	85.72	83.76	82.20
4.70	94.71	90.51	87.19	84.55	82.46	80.80
4.80	94.28	89.77	86.21	83.40	81.19	79.44
4.90	93.86	89.04	85.25	82.28	79.95	78.12
5.00	93.44	88.31	84.30	81.17	78.73	76.82
			INTEREST 4%.			
3.00	104.61	108.58	112.01	114.96	117.50	119.69
3.10	104.14	107.69	110.73	113.34	115.58	117.50
3.20	103.67	106.80	109.47	111.75	113.70	115.35
3.30	103.20	105.92	108.23	110.19	111.85	113.27
3.40	102.74	105.05	107.00	108.66	110.05	111.23
3.50	102.28	104.19	105.80	107.15	108.29	109.24
3.60	101.82	103.33	104.60	105.67	106.56	107.30
3.70	101.36	102.49	103.43	104.21	104.87	105.41
3.80	100.90	101.65	102.27	102.78	103.21	103.56
3.90	100.45	100.82	101.13	101.38	101.59	101.76
4.00	100.00	100.00	100.00	100.00	100.00	100.00
4.10	99.55	99.19	98.89	98.64	98.45	98.28
4.20	99.11	98.38	97.79	97.31	96.92	96.61
4.30	98.66	97.58	96.71	96.00	95.43	94.97
4.40	98.22	96.79	95.64	94.72	93.97	93.37
4.50	97.78	96.01	94.59	93.45	92.54	91.81
4.60	97.35	95.23	93.55	92.21	91.14	90.29
4.70	96.91	94.47	92.53	90.99	89.77	88.80
4.80	96.48	93.71	91.52	89.79	88.42	87.35
4.90	96.05	92.95	90.52	88.61	87.11	85.93
5.00	95.62	92.21	89.53	87.45	85.82	84.55
			INTEREST 4½%.			
3.00	106.92	112.88	118.01	122.44	126.25	129.54
3.10	106.44	111.96	116.69	120.75	124.23	127.22
3.20	105.96	111.05	115.39	119.09	122.26	124.95
3.30	105.49	110.15	114.11	117.47	120.32	122.74
3.40	105.02	109.26	112.84	115.87	118.43	120.59
3.50	104.55	108.38	111.59	114.30	116.57	118.48
3.60	104.08	107.50	110.36	112.75	114.75	116.43
3.70	103.62	106.64	109.15	111.24	112.98	114.42
3.80	103.16	105.78	107.95	109.74	111.23	112.47
3.90	102.70	104.93	106.77	108.28	109.53	110.56
4.00	102.25	104.09	105.60	106.84	107.86	108.69
4.10	101.79	103.25	104.45	105.42	106.22	106.87
4.20	101.34	102.43	103.31	104.03	104.62	105.09
4.30	100.89	101.61	102.19	102.66	103.05	103.35
4.40	100.44	100.80	101.09	101.32	101.51	101.66
4.50	100.00	100.00	100.00	100.00	100.00	100.00
4.60	99.56	99.21	98.93	98.70	98.52	98.38
4.70	99.12	98.42	97.86	97.43	97.08	96.80
4.80	98.68	97.64	96.82	96.17	95.66	95.26
4.90	98.25	96.87	95.79	94.94	94.27	93.75
5.00	97.81	96.10	94.77	93.72	92.91	92.27

TABLE 37.—*Bid on a bond for $100 to realize a given net income, interest payable semiannually*—Continued.

INTEREST 5%.

Net income.	5 years.	10 years.	15 years.	20 years.	25 years.	30 years.
3.00	109.22	117.17	124.02	129.92	135.00	139.38
3.10	108.74	116.23	122.65	128.16	132.89	136.93
3.20	108.26	115.30	121.31	126.44	130.81	134.55
3.30	107.78	114.38	119.99	124.75	128.79	132.22
3.40	107.30	113.47	118.68	123.08	126.80	129.94
3.50	106.83	112.56	117.39	121.45	124.86	127.72
3.60	106.35	111.67	116.12	119.84	122.95	125.55
3.70	105.88	110.78	114.86	118.26	121.08	123.44
3.80	105.42	109.91	113.62	116.70	119.26	121.37
3.90	104.95	109.04	112.40	115.18	117.47	119.35
4.00	104.49	108.18	111.20	113.68	115.71	117.38
4.10	104.03	107.32	110.01	112.20	113.99	115.45
4.20	103.57	106.48	108.84	110.75	112.31	113.57
4.30	103.12	105.64	107.68	109.33	110.66	111.74
4.40	102.67	104.81	106.54	107.93	109.04	109.94
4.50	102.22	103.99	105.41	106.55	107.46	108.19
4.60	101.77	103.18	104.30	105.19	105.91	106.47
4.70	101.32	102.37	103.20	103.86	104.38	104.80
4.80	100.88	101.57	102.12	102.55	102.89	103.16
4.90	100.44	100.78	101.05	101.27	101.43	101.56
5.00	100.00	100.00	100.00	100.00	100.00	100.00

INTEREST 6%.

3.50	111.38	120.94	128.98	135.74	141.43	146.20
3.60	110.89	120.01	127.63	134.01	139.34	143.81
3.70	110.41	119.08	126.30	132.30	137.30	141.47
3.80	109.93	118.16	124.98	130.63	135.30	139.18
3.90	109.46	117.25	123.68	128.98	133.34	136.94
4.00	108.98	116.35	122.40	127.36	131.42	134.76
4.10	108.51	115.46	121.13	125.76	129.54	132.63
4.20	108.04	114.58	119.88	124.19	127.70	130.54
4.30	107.58	113.70	118.65	122.65	125.89	128.50
4.40	107.11	112.83	117.43	121.14	124.11	126.51
4.50	106.65	111.97	116.23	119.65	122.38	124.56
4.60	106.19	111.12	115.05	118.18	120.67	122.66
4.70	105.73	110.28	113.88	116.74	119.00	120.80
4.80	105.28	109.44	112.73	115.32	117.36	118.98
4.90	104.83	108.61	111.59	113.92	115.76	117.20
5.00	104.38	107.79	110.47	112.55	114.18	115.45
5.25	103.26	105.78	107.72	109.22	110.38	111.27
5.50	102.16	103.81	105.06	106.02	106.75	107.31
5.75	101.07	101.88	102.49	102.95	103.29	103.55
6.00	100.00	100.00	100.00	100.00	100.00	100.00

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